

November 10, 1958

McDonnell 120
Design Details

Ferrite Cores
Reduce Circuitry

Aviation Week

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De Havilland DHC-4 Caribou



To make smart maneuvering to stay ahead is the highly competitive aerospace fastener industry. It takes a (special) improvement. Refinement.

The H 20 Keylock 12 point high tensile nut is an example of how a Kaynar original displaced old, heavy fasteners. Developed in 1954, this modern, lightweight self-locking nut is the 310,000 PSI class pushed the "heavier" right off the sidelines. And no wonder! The new H 20 was 50% lighter—all metal, no slots, no inserts.

Kaynar then introduced the Keylock H 25 self-locking nut with reduced wrench size—an improvement on the H 20 (due made it 20% to 30% lighter and provided additional weight space savings).

Later refinements came in early 1959 with the Keylock H 24 (a 230,000 to 240,000 PSI)—where strength in stress and elongation is required. The H 24 has complete load carrying threads throughout its length. Combines exclusive self-locking nut design with perfluoropolymer type mold-in-place double filaments to insure self-locking at pressure in the existing hole.

Always one jump ahead...

...that's why Kaynar's all metal self-locking nuts continue to set standards of progress.

If you have a special lock nut problem, your Kaynar Sales Engineer will be glad to help you solve it.

KAYNAR -

*always
one
jump
ahead!*



KAYLOCK
All-metal self-locking nuts

KAYNAR MFG. CO., INC. • KEYLOCK DIVISION
World's largest manufacturer of lightweight all-metal self-locking nuts

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Result: the Army's Jupiter—and other ballistic missiles of the future—will look to Goodyear-built nose cones to bear the heat of white-hot re-entry into the earth's atmosphere.

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3

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THIS Gask-O-Seal

**EXCEEDS
HERMETIC
SPECS!**

Gask-O-Seals often exceed or exceed specifications for hermetic sealing. The one closest here, for instance, has eight sealing points and is an one of our recent models. The leakage rate is less than the original hermetic seal specifications called for, which is about as perfect as you can get.

Gask-O-Seals are high and low pressure craft seals which require NO special machining to accommodate. A flat surface with only a 1/32 inch as-finish finish is all you need to provide to get gas-tight sealing with a Gask-O-Seal.

There are many other outstanding features about Gask-O-Seals. Limited time for brief sketch, no time of physical strength, rapid repair to install and replace, no extensive build up possible in seal cavity, etc. Why not find out about Gask-O-Seals and the other seals of Parker Seal Company's "Gask-O-Seal Family"—by the action of Parker O-rings.



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Temco's black box with the brilliant future in radar electronics. A radically new system which can augment its carrier's radar cross section from one up to 60 square meters, greatly increasing its visibility on radar sets, READ is the product of years of basic microwave research.

The READ system weighs approximately 10 pounds and can be installed in nearly all drones built to date. A new traveling-wave to amplifier application, READ is effective with either PPI or A scope radar. A single unit will cover the entire S-band or X-band, and can be used in bistatic systems (in which the transmitter and receiver are located at different points).

The development and production of READ is representative of Temco's advanced capabilities in microwave technology, growing as rapidly and substantially as the industry it serves. Temco's complete systems capabilities are ready to meet **your** challenge.

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MISSILE
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NEED
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*Patent Pending

what is energy?

A match burning?
A solar flare?

Is energy really concerned or were
Joule, Boltzmann, Mayer and Men-
well only partly right?

Is the Phoenix concept of applied
energy valid?

An accurate definition of energy
is important to Allison because
energy conversion is our business—
and we have a deep and continuing
interest in energy in all its forms.
Basic to our business is an intimate
knowledge of every form of energy—
solar, nuclear, thermal, chemical,
mass, magnetic, electrical, mechan-
ical and radiant. We search for
this knowledge to increase the
effectiveness with which we accom-
plish our mission—exploring the
needs of present and future flight
and space propulsion systems.

Energy conversion is our business.



WEATHERHEAD *Announces* AVIATION & MISSILE GROUP to better SERVE the accelerated SPACE AGE

Weatherhead announces a new Aviation and Missile Group composed of three plants strategically located to speed the development and production of vital aircraft and missile hydraulic and pneumatic components.

Located in the heart of the west coast aircraft and missile industry, the Western Aviation Division in Glendale, California, will be expanded to specialize in the development of fittings and valves and the manufacture of short lead time production items.

The mid-west operation headquartered in Cleveland, Ohio, will concentrate its facilities on valve and production items. A research and development center will devote its efforts to the development of flexible fluid line assem-

blies, hydraulic actuators, and fluid valves and pressure vessels for the advanced hydraulic, pneumatic and fluid systems of today's aircraft and missiles.

The Eastern Aircraft Products Corporation, a Weatherhead subsidiary in Orange, New Jersey, will specialize in quick disconnect couplings and special valves of similar construction.

Ready to meet the ever increasing demands imposed by our sophisticated space age, each of these plants will be continuously expanding engineering, manufacturing and sales facilities on a local, regional level.

WEATHERHEAD AVIATION and MISSILE GROUP



First powered U.S. space probe ship, the X-15, will make a red-hot journey into earth's atmosphere — but it's designed to avoid burning up. Skin is made of Inconel "X" alloy.

How X-15's red-hot comeback will be handled

As X-15 streaks in from space, air friction heats its nose, leading edges to a dull glowing red in seconds. Even side panels reach about 1000° F! If skin weakens too much, air loads tears it off the ship.

In these highly stressed skin areas, designers of the X-15 use Inconel "X" — age-hardenable nickel-chromium alloy. It has high-temperature strength and heat resistance, plus high-temperature creep resistance.

After forming, X-15's skin is treated to specification by chemical milling. The process, Chem-Mill[®], was developed by the ship's manufacturer, North American Aviation, Inc.

Following acceptance flight tests, the rocket-powered X-15 will be turned over to the Air Force, Navy, and National Advisory Committee for Aeronautics.

Perhaps one of the standard Inco Alloys will help your products get off the ground — and back — safely. Talk it over with the Inco Development and Research Division.

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INCO NICKEL ALLOYS



One of GPL's ground speed and drift angle measuring equipments, AN/APN 81, provides bank, pitch information to computers which tell Air

Force WB 50s exactly where they are every flight second. GPL auto navigators give an instantaneous and continuous display Ground Speed and Drift Angle; Wind Speed and Direction; Longitude and Latitude; Shortest Course To Destination; Bearing Signal To Pilot (or autopilot).

The systems were developed for the Air Force (WADC). They are the result of an inherent capability in mathematics in the handling of the vector. GPL's handling of the Doppler effect is an achievement. The benefits of these GPL systems extend to every area of flight. Their capabilities have just begun to be explored.



ground speed & drift angle

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One look and the pilot **KNOWS**. At a glance, he reads actual ground speed and drift angle, displayed on his flight panel — automatically, accurately, and continuously.

How? Through the famous RADAN® family of self-contained GPL Doppler auto-navigators, recently released for civilian use.

For civilian aircraft, RADAN systems mean pinpoint navigation, reliability, savings in precious time and fuel, a priceless margin of safety. In its wide and growing applications for the military, RADAN provides all these, and continuous velocity data as well.

Trademark

ENGINEERS — GPL technicians have spent up some unusual research and development expenditures. Don't dream in Pittsburgh, Mexico.

GPL systems have behind them many millions of operational miles in transcontinental, oceanic and polar flight. RADAN systems handle a new era of faster, safer, more economical civilian flight.

RADAN is ready and available now to everyone.



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The PLANE

U. S. Navy's Douglas A3D Skywarrior, twin-jet attack bomber. An extremely powerful carrier-based craft, the A3D can deliver nuclear bomb loads. It is capable of high subsonic speeds and has held the round-trip transcontinental speed record. In production at El Segundo division of Douglas Aircraft Co.



The PROBLEM

Maintaining an effective cord seal on the Pratt & Whitney J57 engine nacelles. High engine heat within and the extreme cold of upper altitudes require the seal to stay resistant despite widely varying temperatures. Seal material should also resist salt spray, ozone and weathering.



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Temperature range, °F.	-120 to 300
Chemical resistance	excellent
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for the conquest of space

IS THE ROCKET ENGINE MAN'S ONLY WAY TO OUTER SPACE?

Stalled and snafused against the relentless grip of acceleration, a man has upped and high-tail as his crew of robot devotes controls the upward drive of his ship. He watches the firing seconds tick away—300 . . . 450 . . . 600—until suddenly, both sound and acceleration disappear simultaneously. In that second all weight ceases.

He is in Outer Space.

The only power that can put him there today is the large rocket engine. No matter how far and how fast space travel develops, these high-thrust engines provide one basic essential—the sheer brute force that can lift a payload from the surface of the planet to the airless void outside.

Endurance for vast distances

Once space is reached, a wealth of intriguing possibilities beckons. Entirely new aspects of propulsion are being developed to answer ships between the moving grasp-

PACKAGING OF SPACE. Only where to put science or people and beyond atmosphere to the big, high-altitude rocket.

FIRST WITH POWER
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A Division of North American Aviation, Inc. Downey, Calif. California, Nevada, Missouri

tational fields of Earth's neighbors in the solar system.

One advanced propulsion system that may be built soon is an ion rocket. This ultra-high-specific-impulse power plant provides low thrust for extended periods.



OUTWARD BURN, ion's silent superior leads off in a rendezvous with planets there.

An endurance of months, or even years, is possible. Mounted in a suitable unmanned vehicle, with an interplanetary "private eye" would make the customer region seem like our own front yard. It could be sent off to reconnoiter the mysteries of Mars, Venus, or the Asteroid Belt.

Rockets ready today

To date, the vast bulk of successful missile and space projects in America have used Rocketdyne engines—Atlas and Thor for the Air Force, Jupiter and Redstone for the Army, the historic Explorer satellites, and the all-important first stage of the lunar probe. And Rocketdyne continues to improve the techniques of rocket engineering. High-energy fuels—stability—a full range of proven engine designs; these are some of the contributions Rocketdyne has made to weapon system operation for our nation's defense.

Million pounds of thrust

Rocketdyne is now at work on two super-oxidic propellant systems that will deliver thrusts up to 1,500,000 pounds. One is a single-chambered engine, the other a grouping of engines adapted from the Thor-Jupiter engine family. From these will stem the multi-million-pound-thrust systems that are essential to launch the manned exploration of interplanetary space.



The 140-ton vacuum furnace (right) and the Air Force Space Technology Laboratories.



Left: General, the vacuum furnace and gas-tight system are checked out.

Project Able, started out by Space Technology Laboratories for the Air Force, has provided scientific data of fundamental importance for successful penetration of the atmosphere from space.

The first Able launch occurred April 23, 1958, only four months after the initial design discussions. During those four months STL's Electronics Laboratory designed, fabricated, tested and installed the second stage autopilot, guidance and all electrical and electronic systems, including radio and ground telemetry and checkout equipment.

This effort illustrates the contribution of Space Technology Laboratories to space experimental application, from designing, packaging and testing of hardware, to complete field operations.

A number of openings are currently available on our Laboratories' staff for those who can make significant contributions to space flight programs.

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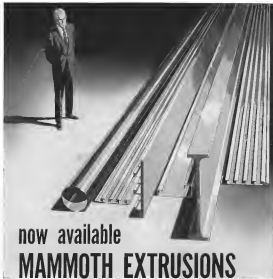
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EDITORIAL

Missile Industry Myth Fades

Not long ago there was a concerted effort by people, whose motives are best known to themselves, to promote the myth that ballistic missiles were an "ultimate weapon" that would replace powered vehicles for military purposes in the same manner the automobile has replaced the horse. At the same time they also fabricated the fiction that a new and separate industry, having no roots in the technological past, would sprout full blown to research, develop and produce missiles.

At military levels, this myth quickly disintegrated as the pace of technical reality. We now have a military program that evaluates realistically the important role of missiles as part of a mixed arsenal. Certainly the intercontinental ballistic missile will play an important role in current and future military planning. But it is by no means an "ultimate weapon." Nor is there ever likely to be any such thing. In addition to the ICBM as an important military weapon, missiles will be used with more mobile launching platforms, (either air or water-borne) than the concrete prisms of a fixed ICBM launching complex. Nor has the concept of a separate missile industry crystallized from the events of the past year. As we pointed out more than a year ago (AW Sept. 16, 1957, p. 21), the bulk of the early research and development work on missiles of all types was done by the aviation industry with Convair, North American, Martin and Aerojet-General in the Vanguard.

Look of the Present

Now let us look at the current situation to see who are the prime contributors to the major missile weapons systems now in advanced development as early production and who has received the major new missile contracts awarded in recent months. Are they now and unknown names in the traditional context of aviation industry firms? Or are they the old, familiar names who have been in the usual vehicle population and gasoline business for 30 years or more? In the long range ballistic missile field, there is Convair with Atlas, and Martin with Titan, Douglas with Thor, and, as exceptions to the rule, Chrysler building the Redstone Arsenal-developed Jupiter. For the Navy, Lockheed is developing the solid-propellant Polaris. Last Army missile project is the Pershing for which The Martin Co. is prime contractor under a weapons systems management concept. For smaller missiles there is Hughes Aircraft with its Falcon development line, Martin with the Bullpup and White Lancer, North American with Firebird, Fairchild with Goose and Cardinal. In the missile defense area the Douglas Aircraft Western Electric team for Nike Hercules and Zeus and the Convair-Radio Corporation of America team for Wizard are no strangers to the scene.

The most concerted effort to crash into the missile business was made by other industries on the USAF Minuteman missile system. Who got the management contract? Boeing Airplane Co., which is also building the Boeing air defense missiles. Boeing's associated contractors for propellants, guidance and other components are also familiar names in the aviation business.

What is the picture on our efforts to probe the unknowns of outer space? The first and military efforts in this line are the Lockheed-Singer reconnaissance project for which research has been done for many years past and the Drosos project on which the Boeing-Convair and Martin-Roll Aircraft teams are working. The workhorse of long-range space exploration now is the Douglas Thor with an Aerojet-General second stage combined in the Pioneer moon probe. For the immediate future, space efforts will be based on the Convair Atlas and Martin Titan missiles with Pratt & Whitney Aerojet second stages.

In the current competition of the National Aeronautics and Space Administration for space capsules of the 10 billion mile tour are not firm long part of the aviation industry complex.

No Closed Circuits

Does this mean the missile and space business is a closed circuit with no room for new firms and new technical specialties? Certainly not. The aerial vehicle banner that began when the Wright brothers switched their own interest from bicycles to experimental gliding is still in a process of major change. The aviation industry has never been able to rest on its technical laurels and it certainly cannot do so now. As the technical spectrum expands it will require the addition of new firms with new technical specialties and the conversion of current experimental research into the hardware of tomorrow. There is ample room for new firms to fill out the technical spectrum. In a more precise field, the expansion of the ground handling equipment and checkout requirement has opened a fertile new field of supplementary business. The current aviation industry must and will expand its technical base to handle the new myriad of problems arising from missiles, space exploration and extremely sophisticated aerial vehicles of all kinds.

It is the aviation industry that has built the research facilities and engineering staff capable of this advanced development work. But even more important than these vital factors is the conscious drive into the unknown that has characterized the people working in the aviation industry down its first days of space, war and digital circuitry to the hypersonic speeds of missiles and the long journeys into outer space.

—Robert Elton

In the Front Office

Frederic W. Correll, vice chairman of the board of Douglas Aircraft Co., Inc., Santa Monica, Calif., has also been named vice president manufacturing. Arthur E. Reynolds was named senior vice president engineering. Douglas also named the following vice presidents: Edward F. Betton, director of program research in avionics engineering; Edward M. Hinesman, director of research aircraft systems support; Elmer F. Winkelman, director of research and operations; William J. L. Hunt, general manager Tulsa, Okla.; Vincent S. F. Smith, general manager Charlotte, N.C.; Detroit.

Dr. Joel S. Imberg, president and chief executive officer, acquired Flight Systems Laboratories, Inc., Buffalo, N.Y. Also, Dr. Kenneth Pines, senior lecturer

George R. Schuster, president, Controls Int'l Company Corp., Cleveland, Ohio.

Dr. William A. Shaw, Jr., executive vice president, Vero Laboratories, a division of Vero Corporation of America, Silver Spring, Md., Arthur A. Locke, research director, is director of Vero's West Coast Laboratory. Dr. Levin H. Rogers succeeds Mr. Locke as research director. Mrs. Andrew J. Robinson, vice president, Vero Laboratories, and civil engineer, Vero Weapons Services, Falls AFB, Ohio, Edward W. Chiao, assistant general manager of Weapons Services at Falls AFB, Ohio.

Carl Selway Shuler (IBM int'l) vice president-computing and research IBM Research Corp., Palo Alto, Calif.

Shay Korman, executive vice president United States Steel & Chemical Corp., Los Angeles, Calif.

Honors and Elections

William C. House, director of Aircraft Systems Division, Newport Central, Calif., Vero, Calif., has been granted a one-half year of sabbatical leave with the Advanced Research Projects Agency of the Department of Defense, at the request of Ron W. Johnson, AFOSR, director.

An F-4's Air Photographic Service has been awarded the 1975 "Sagittarius Trophy" for "the most outstanding photo taken in support of national security in the field of Air and Letters."

Michael Sabin, director of the National Safety Council's Award of Honor for its outstanding 1975 safety record.

Changes

Clay A. Evans, manager of engineering, Turbineco, A. Hamilton, director of business development, General Electric Corp., Wilkes-Barre, Pa.

Samuel W. Chaffee, director of research and development, The Allen Vandebrink Co., Bloomfield Hills, Mich. Also, Elbert E. Frost, vice manager.

Stefie G. Noveck, senior electronics engineering manager, General Electric Corp., Los Angeles, Calif.

A. E. Haines, sales manager, Southern Instruments, Inc., Los Angeles, Calif.

(Continued on page 117)



Think small

Mechanical brains for missiles must be as tough and tiny as possible... a design problem that calls for experts skilled in both electronics computers and microtechnology.

Arma's computer group has shrank a digital computer module until it's the size shown above... a feat comparable to squeezing the contents of a steamer trunk into a cigarette package.

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INDUSTRY OBSERVER

► Range of airborne intercept radar being developed by Hughes Aircraft for use on North American F-108 long-range intercepter is expected to be at least as basic as the range of existing interception radars, making the F-108 the less dependent upon ground-based radar for guidance and surveillance. Increased range, high, close-in use of non-extended, low-peak power radar simplifies (AW Aug. 4, p. 69; Sept. 1, p. 61).

► An F-4's new GAR-9 air-to-air missile (see p. 31) being developed for use in the F-108 is expected to have a range three times that of present GAR-7 (Beebe) missile. New GAR-9, which can be refueled with nuclear warhead, also is expected to be the most maneuverable than present Falcon.

► Tests of upward ejection seat for Lockheed's F-104 Starfighter, which may replace the seat's present downward ejection system, are being conducted on the high speed track at Edwards AFB, Calif.

► Use of North air boundary layer control on the leading edge of the Lockheed F-104 wing is expected to reduce the aircraft's approach and landing speeds by 15-20 ft.

► In tests of North American Avionics X-45 high-altitude research aircraft, the Boeing B-52 bomber plane will be equipped with closed-circuit television to appear its own instruments of the aircraft in the aircraft cockpit during the entire time it is being tested to simulate and test the drop.

► Initial Air Force study on North American T-39 Sabreliner utility transport (AW Nov. 3, p. 56) in its seven aircraft reflects that the three original configurations, USAF is considering use of Pratt & Whitney JT12 turbojets, which could be fitted in the Sabreliner with a slight increase in payload. To conduct any such study, look for General Electric to want to boost the thrust of its J85 turbojet, which now powers the Sabreliner, from 2,500 lb. thrust to over 3,000 lb. of the JT12's 2,900 lb. rating.

► Probability of survival of small and medium aircraft under forward and down, portions of a forward battle area is being studied by the Army at its Combat Development Experimental Center, Ft. Ord, Calif. The study will provide information for developing techniques for reducing the aircraft's vulnerability. Series of similar studies includes COEIC, Defense Research Laboratory, Johns Hopkins University's Operations Research Office, and the Army Aviation Center.

► McDonnell F-101, scheduled to replace the Northrop F-89 at Air Defense Command's long-range interceptor, will carry its Douglas General M3-1 nuclear armed air-to-air missile enclosed in the belly rather than on wing pylon as in the F-89.

► An F-4's three intermediate range ballistic missile (AIM-54) will be at a rate exceeding 50 g's over a 30 sec. Manoeuvring, appears to be capable of guiding about 30 deg. from the vertical trajectory for thrust vector control. Various engines have even greater guiding range.

► Quick-opening parachute for use by low-flying Army flying platforms and VTOL/STOL aircraft powered is being developed by the Development Research and Engineering Command, Natick, Mass. Designated the XMP-2, the parachute has a 34 ft. canopy diameter, is designed to open fully in 5/10 sec. Power change drives a piston that opens 24 steel legs to extend the shock lines.

► During Army evaluation of the Sad Dyma YH-103H two-man helicopter, reported for trials by Hughes Aircraft Corp., operators and the aircraft averaged 58-64 mph in the hovering and maneuvering, during 164 ft. of flight path. Dyma is in the same class with the two-man Hughes YH-20 and Beechcraft helicopter. Army currently has no requirement for this class, but manufacturers hope one will be developed.



Barden Precision ZBW5M bearings specially designed for a gyro gimbal

BARDEN Precision ball bearings set today's performance standards



The Test Rig: In high precision bearings, the high precision bearings are designed by Barden for accuracy, reliability, and long life. In the case of many Barden bearings, the design is so precise that the bearing is used for quality control or functional testing of Barden Precision ball bearings.

For accurate gyro indicators, gimbals need bearings with extremely low and predictable torque reactions. Other demands are extreme accuracy of rotation and exact positioning of the gimbal.

All standard Barden Precision bearings meet critical requirements for low torque and mechanical accuracy. In addition, the special purpose ZBW5M has these important design features:

- Barden-developed "BB" retainer — for maximum torque peaks — eliminate "windup"
- Precision flanges — for precise positioning and alignment — rigid mounting

Size M is exposed — to prevent entrance of foreign matter

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Washington Roundup

Heladay: Space Arbitrator

William M. Heladay, contractor Defense Department chief of special studies whose office has submitted cost studies for the thousands of decontamination projects, has stepped over on White House appointments to head the executive Civilian Military Liaison Committee. Duty of the committee is to study disputes arising between the National Aeronautics and Space Administration and the military services over roles and missions in the nation's space program.

Defense Department appointments on the committee for Ray W. Johnson, director of the Advanced Research Projects Agency, Maj. Gen. R. P. Stafford, Air Force assistant director, chief of air civil development; Maj. Gen. W. W. Deth, director of special weapons; Air Force Vice Admiral R. B. Pace, deputy chief of naval operations for air; Civilian representatives are Dr. Hugh L. Davies, deputy director of the National Aeronautics and Space Administration; Dr. Alvin Silverstein, NASA director of space development; Dr. Homer J. Stewart, NASA director of program planning and evaluation; and Dr. L. H. Altman, NASA assistant director for aerodynamics and flight characteristics research.

Security Virus

Security virus has infected the speech circuit in the Pentagon again, leading to public complaints by a new lot of top military officers in recent weeks. Campaigning for the form of all the staff usually made and before the speaker delivers his prepared text. Each of course have been denied by the security reviewers. One recent speaker charged that his talk also had been "censored." Another, a high ranking Navy officer, said his audience he would attempt to "give you a new view within the strictest of security in which we operate."

Prophet Weary

Vice Adm. R. B. Pace, deputy chief of naval operations for air, let it be known last week that he has become a little weary of military prophets who insist that the armed service is dead and of their counterparts who believe and as strength that they must do battle with the world, in order to save the world. Speaking at an Air Force Western Area luncheon last week.

In his shop, "we cover the entire gamut from fleet battle to nuclear to logistic support. I have seen eyes wide for weapons and weapons for support. We are now of the opinion that we are not competitors. We believe that weapons must be the agent of destruction or defense and that the aircraft and ships are the usable platforms."

Consequently, it is evident that competition is among weapons themselves and among aircraft and among ship platforms.

Election Notes

Republican standing on the Senate Commerce Committee, with parallelism in the House members will be substantially changed to the next session of Congress as a result of the elections. Four of the seven Republican members were defeated. Sen. John Bayley (R-Mt.) and Sen. Charles Potter (Meb.) lost. Sen. William P. Clark (R-Mt.) and Sen. Frank Lautenberg (N.J.) were re-elected.

Schuyler (R-Iowa) will step into Bayley's position as ranking minority member. Other significant elections:

- Jennings Randolph, until recently director of public relations for Capitol Hill, was a Democratic Senator from West Virginia. Randolph specialized on nuclear matters during 14 years service in the House.
- Sen. Stuart Symington (D-Mo.), former Secretary of the Air Force and a member of Senate Armed Services Committee, who has led congressional action for a stronger defense effort, was re-elected to a second term.
- Sen. Henry Jackson (D-Wash.), member of the Armed Services Committee and chairman of the Joint Atomic Energy Subcommittee on Military Applications, who has teamed with Symington in pushing the Administration's expansion of commerce, also was re-elected.

Farty Winks for CAB?

American Airlines feels that "Time World Airlines" lately advertised "faster seat service" may have killed Civil Aeronautics Board inquiries into an operational 40 weeks. After receiving a complaint by American and United more than a year ago, the Board has been assigned plans to have the service as "instant" since TWA offered the "disappearing" in first-class class. American provided the CAB last week, reminding it that the board Board under review, to halt the practice still hadn't been used. The Board's decision, American charged, had allowed its competitor to "loot" the fruits of its violation. For more than a year.

Retreat From Space

German politicians reject Dr. Hermann Oberth's intention to Germany after completing a three-year contract as a consultant at Ames Research Agency in Hawthorne, Ala. The 64-year-old Dr. Oberth, who believes the next rocket missions within the next 25 years will be concerned with the human element rather than with space, said he plans to devote the latter effort, devoting full time to the study of psychology, extra-sensory perception and related fields.

Charter Dispute

Civil Aeronautics Board has received its Sept. 5 order granting foreign air carriers the right to conduct all route charters. Strong protests from both U.S. carriers and some foreign airlines against the Board to postpone the effective date of its order until Dec. 5 to allow time to study the situation later. U.S. carriers say that foreign governments require regulations for both as well as route charters that are much more strict than those applied by the Board. They are urging CAB to make demands of all route charters in foreign carriers by duplicating the rules their governments impose on U.S. airlines.

Route Survey

Long-term route surveys are moving under close scrutiny. In the Civil Aeronautics Board which feels the expense involved might be lowered to some extent by studying out new routes to stop. The Board is investigating 60 routes in an effort to lower the cost of service. Airlines on temporary three-year certificates, Board members feel that the stop which has not yet passed on average of five passengers each during the past year should be dropped.

—Washington staff

ARPA Official Hits Space Role Transfers

Truax defends military space needs, fears U. S. may overstep in assigning projects to NASA.

By Evert Clark

Washington—How that the U.S. may go too far in defining new projects to civilian control has been stated by an official of Defense Department's Advanced Research Projects Agency.

Navy Capt. Robert C. Truax, an ARPA military assistant and space program "chick 1" and main adviser to ARPA, felt on absolutely necessary to the military exploration of space, and will be transferred to hold it in part to the civilian National Aeronautics and Space Administration.

The move first has been expressed privately by members of the three main services and has been limited to public by other ARPA officials. Thus reply to the Washington chapter of the Aerospace Budget Society.

He proposed a combined ARPA-NASA industrial planning and management group to avoid both the transfer of necessary military projects to civilian control and unnecessary duplication, particularly in hardware development. This suggestion, he said, went far beyond personal observations on how the space program might be handled and not least of all agreed.

It is recognized which agency carries out in given project, Truax said, so long as efficient coordination of requirements and progress continues, to that efficient and cooperative organizations. But "perhaps the most

hazardous to such coordination is the current attitude of some that space is mostly science and the question the only has, can they sit in the scientific and keep ahead of the service on all deep-and deep-sea work.

Space is not an easy issue to be solved for the scientific," Truax said. "It is not such generally scientific in nature if we understand science to mean a search for measurement of environment."

"Space development includes those things but it also includes exploration," Truax said.

It is the development of means of transportation. It is basically, establishing a new science."

The problem is to concentrate on not getting into a race, launch, race, race," he said. "There are problems of engineering. They are in the application of largely known techniques in a somewhat different fashion to get on somewhat different results."

"We shall start a dangerous and perhaps a fatal mistake if we put the control of space development in the hands of the pure scientist."

Truax said he and some others are certain that the problems of technical planning can be worked out within the present structure but that "one sign of coming into space will be the transfer of NASA and ARPA were to combine their technical planning and program

management activities into a single organization under one roof."

This point, supported Space Development Center would:

- Take operations discussed separately by the two agencies and give the technical agencies for achieving those.
- Establish the "agencies" that would have to be made in adapting single items of equipment to multi-purpose use."
- Coordinate technical components with the other groups providing direction and formulate a hardware program."
- Transfer the program, test, into specifications and then into contracts, placed largely with industry, after both agencies had approved.
- Administer the contracts until it had been fully completed.

Such a center should have no more than 500-600 people if coordination of the services are said, and should include "the main of issues, the big picture, as well as the hardware and electronics in all the fields of technology that contribute to space flight," Truax said.

It also should have "which also has outstanding in these fields and have long experience in specifically, the rocket, guided missile and other contributing space field technologies," he said. "There has been emphasis that the old National Advisory Committee for Aeronautics, which forms the nucleus of the space agency, had for rocket and missile specialists and some familiarity with managing major projects, and that the new NASA is far too broad in its technical program."

Truax said the center also should have:

- Sufficient number of "technicians" to provide an independent analytical capability. This is essential to prevent "meeting projects from outside" he is believed on a composite basis."
- Lack of "armor or profit bias" to do so. "It must be adequately staffed with competent people who can give their best to the service," Truax said.
- They must be sufficiently permanent to ensure that there will be no conflict of interest and that there will be adequate cooperation and experience to the major tasks which this organization now will have to perform. Science must be compatible with industry."

ARPA now employs some of its technical personnel through the Advanced Research Projects Division of the pentagon, and it is receiving Defense Analysis. This allows ARPA to use those from private life sometimes for



First Closeup View of Soviet Tu-16

First closeup view of the Soviet Topyev Tu-16 bomber from jet bomber, designed by the NATO (APR 16, 1956, p. 47), shows configuration of aircraft which houses bombing and navigation units. Note on intake its D-3000 jet thrust turbojet engine.

limited periods, and at intervals more comparable to industry pay than what they could receive in civil service positions.

- Clearly defined authority as well as responsibility.

If the thousands of details of technical coordination were handled by such a center, the National Aeronautics and Space Council should be. President Eisenhower then could devote his attention "to such major policy questions as the overall funding level of the space effort and the proper appointment of heads between civilian, military and common efforts; the domestic and foreign political aspects of our space program and other such matters as they are presently qualified to handle."

Truax said he believes "some of our actions in the past may have been somewhat hasty and not too well coordinated," but three steps would "set us on the right track."

- Create an integrated organization such as the development center.
- "We must make sure that the concept of space is generally an engineering problem to achieve a military objective, not perhaps militarily or a scientific problem to achieve a humanitarian objective."
- "Determine a major shift to large and more efficient space vehicles," Truax advocated, doing this on a building block basis, with less standardized vehicles rather than "a large vehicle of special purpose vehicles."

• "Make an adequate level of financing and ensure that level will be on one with the world leaders in space."

Space Technology

NASA Capsule Bidders' Meet Attended by 30 Aviation Firms

Washington—Representative of 30 aviation firms were scheduled to attend a bid opening conference held by the National Aeronautics and Space Administration last week in a first step toward the long-range development of manned U.S. satellite capsules.

The conference held at Langley Research Center, Langley Field, Va. (AW Nov. 3, p. 11), also marked one of the initial steps NASA has taken in its own mission to obtain contributions on Oct. 1.

Cost Near \$30 Million

Technical proposals on the capsule project are due by Dec. 4. Before its bid opening, NASA had received 11 proposals from the capsule development program would approach \$30 million (AW Aug. 11, p. 20).

Proposals at that time included eight test capsules at \$4.5 million and four test capsule subassemblies at \$5 million. Five Thor-Able vehicles or the equivalent would be used for atmospheric and non-atmospheric flights at a cost of \$5.4 million.

Two Cosmos Atlas as equivalent vehicles would be used for non-atmospheric test flights at a cost of \$5.1 million.

Contractors scheduled to attend last week's meeting were:

Franklin Engine and Aircraft Corp., General Electric Co., Grumman Aircraft Engineering Corp., Lockheed Aircraft Corp., The Martin Co., McDonnell Aircraft Corp., North American Aviation, New York Aircraft, Thompson Bureau of Aeronautics, Republic Aviation Corp., Buco Aircraft Co., Lear Inc., Allison Division of General Motors, Sperry Gyro Corp., Westinghouse Electric Corp., Aerojet General, All American Engineering Co., United Aircraft Corp., Watrous Laboratories, Aerovations Systems Inc.

Aerovations Development Corp., American Machine & Foundry Co., Aero Manufacturing Corp., Bell Aircraft Corp., Boeing Aircraft Co., Chance Vought Aircraft, Convair Division of General Dynamics Corp., Cook Research Laboratory and Douglas Aircraft Co.

During congressional testimony on last Dec. 10, officials of the National Advisory Committee for Aeronautics, NASA predecessor, said an Apollo-sized manned capsule could be sent into orbit at about 150 tons on a full scale backup of an NASA capsule of

ARPA Lets Manned Satellite Contract

Washington—Contract for development of a manned satellite weighing several thousand pounds and the propulsion system needed to put it into orbit was being awarded by Defense Department's Advanced Research Projects Agency.

It is believed that the establishment of the National Aeronautics and Space Administration to establish the need for a satellite space agency. ARPA first was awarded a contract with Ford & Whitely, Division of United Aircraft Corp. for the development of a manned satellite orbital capsule to be used in the second stage of the satellite vehicle, NASA also is planning a manned satellite, see page 27.

First stage of the orbital satellite is scheduled to be an adaptation of the Air Force-Cosmos Atlas intercontinental ballistic missile. The satellite itself also probably will be built by General.

The contract, which puts Ford & Whitely into the space business for the first time, calls for an initial expenditure of approximately \$5 million. The ARPA announcement estimated the total development cost at about \$21 million. There are additional costs of the contract to Ford & Whitely is expected to be much higher.

Work on the second-stage capsule will be conducted at both Ford & Whitely's home plant in Fort Worth, Conn., and at its recently completed Florida Research and Development Center (AW Nov. 6, p. 16). Indications for its expanded work on biological tests.

New Technology Boosts Interceptor Role

By Philip J. Klein



Unmanned MAE training series of Genie MB-1 nuclear-armed tactical rocket shown on cart at Toronto AFB, Ont., during USAF gunnery meet (CW Nov. 3, p. 21). Inset of warhead detonation is part by Hughes Aircraft Co. fire control system before landing.

First Detailed Closeup of Genie Ground Handling



An Defense Command Norlarp F-105 are equipped to carry Douglas Genies in racks of two external pylons along with the wings.



Initial value of Genie is at least \$80 to \$100 B, based on pricing in meet when made was first against Ryan Q-2A jet dropper

prober the particular pattern of action the crew will employ," he said.

The effectiveness of human operators in making effective decisions and taking correct action, regardless of whether he sits on the ground or on the air, depends upon the extent to which he knows what is taking place in the battle.

If the man is in an intercepting, he is better able to identify the enemy and establish the nature of his loss, the type of attack that can be most effective, and something of the counter tactics and countermeasures. Predict and Far long-range interception man is able to exercise control over the attack as enemy forces far earlier than a possible if human intelligence is exercised only on the ground, not target that can be detected. Predict and

Advanced Radar

Major advance in performance of the next generation of interceptors will be the use of advanced radar which will extend the range "nose-trail" over current systems. It will largely be the intercepter pilot from current dependent upon ground radar or early warning, which will provide considerably more time for human battle decisions. Predict and

Fourth, superior speed and range of new interceptors such as the F-105, will make it possible to engage the attacking force far more quickly, at greater distances from target areas. The F-105 will have an operational ceiling of at least 1,000 ft., according to a North American spokesman.

Future Missiles

New air-to-air missiles, with far greater range and far more maneuverability, than present weapons, will greatly extend the intercepter's reach. The human pilot must position his intercepter for a successful attack. Next generation air-to-air missiles such as the GARR, will be capable of attacking bombers far below and far above the intercepter.

Thus will keep the intercepter's feet to continue his surveillance of the air battle and to exercise his judgment concerning future action, according to Predict and

Significant advantage of manned interceptors, Predict said, will be its flexibility and the possibility of using it in situations which are cannot now be achieved from towers or in battle area. Quite simply, from these was, present in our defense thinking.

New Hope For CF-105?

Washington-Canadian aircraft industry is making an all-out fight to save the Avro CF-105 Avon and to keep alive Canada's capacity for the original design of high performance aircraft.

Three factors have made considerable hope that the Avon will be purchased in quantity and that the Conservative government of Prime Minister John Diefenbaker will accept its proposal plus to enable completely to maintain the Canadian aircraft industry (AW Sept. 28, p. 22). They are:

- Avro is achieving its performance perfection and has reached 2,800 mph ground by the Post & Whitney JT-11 engines and that the Gravelly (Drops) engine, which delivers more thrust and weighs less than the JT-11, will give the Avon a top speed of about 3,000 mph., or in excess of Mach 3 at 40,000 ft. and above.
- Avro has secured its cost estimates for the Avon in light of the replacement of the RCA Avon intercepter the control system, which is an development with a performance potential made by Hughes Aircraft. The new price is \$5.5 million per aircraft for a lot of 100 Avons. The price last summer was \$4.6 million per aircraft for a similar quantity.
- All requests of Canadian aircraft industry are reported to be applying themselves to the Avon and the technical effort is being made to deliver of weapons equipment and accessories in time to meet the requirements that will be born out in the first flight of the Avon-powered Avon.

Canadian hopes center around making only trouble with the Avon and where the Mach 3 speed intercepter. The Avon program is scheduled for a formal conclusion by the Canadian government in March.

Speculation is that it will be difficult for the Avon to be sold in 1956. The Avon will be in use for two years before other Mach 3 aircraft are in development and would give Canadian industry an achievement that could not be ignored.

Prime Minister Diefenbaker announced earlier that Canada would buy the Boeing Boeing missile and establish two lines from which to operate them.



BOMARC doesn't begin its one of three launch types until installation of the first Bomarc intercepter missile experiment launch site on Santa Rosa Island, Fla. Designers swing open its mounds, permitting the missile to be quickly erected and launched by remote control.



First Bomarc Site Nears Completion



MISSILE is ready for remote launching. Improved Bomarc, DM-99B will be tested at the Santa Rosa Island site. Crews also will be trained here in assignment to other Bomarc sites.

Santa Rosa Island, Fla.—Two Air Force Bomarc (DM-99A) intercepter missiles to be fired from a site other than the Cape Canaveral, Fla., test center is scheduled to be launched on Dec. 4 from a new Air Defense Command center nearing completion here.

The 575,000-hi site near Eglin AFB will be used for evaluation of the new 400-mph range Bomarc B (DM-99B) as well as for control training and periodic evaluation of crews that will man the remote Bomarc site.

Interim, launched from Santa Rosa will fly over the Gulf of Mexico range under control of the SAGE II or its future control center at Mountainview, Ala. is of a one-on-one AN/GPA-1 intercepter control at Eglin (ENR Aug. 15 p. 55). Missile will be tested in meeting air defense roles located along Florida's Gulf Coast and guided to targets of data fed to the control of the target where Bomarc's own radar will take over.

Control is operated by the 4751st Air Defense Wing (AW) commanded by Col. Joseph Myers, under the 71st Air Division (AD) located at nearby Tyndall AFB.

Three different types of Bomarc launch stations are being constructed at Santa Rosa for comparative evaluation. In one type, the entire missile splits down the center and opens like a champagne bottle. In the other two types, both of less expensive construction, only the nose opens to permit missile firing. Each launch station houses a single Bomarc mounted on a launch cradle, an elevated launcher that can be elevated from horizontal position to required elevation angle in a matter of seconds

upon command from the remote SAGE center.

Critical circuits in the missile are continuously and automatically checked in a 24-hr loop to insure that because in a continuous state of readiness, according to an Air Force spokesman. The missile will be given a complete operational check-out on its launcher every 30 days, pulled out and returned to Hurlbert Field for full inspection and test every six months, according to present plans. Facilities at Hurlbert include mounds to be subjected to simulated shock and loading conditions. Being in setting up an experimental launch at Hurlbert to support initial flight tests on Bomarc-II started to begin early next year. Range of the new version will be more than 400 mi., better than twice the range of DM-99A. New version will use solid propellant boosters rather than of present liquid fuel, a change, that is expected to greatly simplify ground handling and launching procedures. New version will continue to use the underlying Marquardt engine, but improved performance is expected to boost the Bomarc-B speed above the present Mach 2.5 figure.

Nike-Zeus May Be Inadequate, Top Defense Scientist Warns

Atlanta, Ga.—Nike-Zeus ballistic missile defense system cannot provide effective against defense against multiple ballistic missile threats, doves and other persons warning, reporting that anti-missile missiles and radar weapons that the U. S. can afford to deploy, according to a top Advanced Research Projects Agency scientist.

Dr. Richard Holbrook, scientist in ARPA's ballistic missile defense group, Institute of Defense Analysis, says current nose, techniques, ideas and concepts are needed to develop an effective ballistic missile defense system.

ARPA plans to spend \$100 million this year to investigating such new techniques, would need to spend \$400 million to find all the projects it has covered. Dr. Holbrook said in talk at the Atlanta chapter of August 1968, the National Academy of Sciences.

Dr. Holbrook, cited the following as examples of the difficult problems that would be solved before the nation can develop an effective defense against ballistic missiles:

- Doves. Metal-cased nuclear balloons weighing only a few ounces can be shaped to look like a nose cone without

- Infrared. Small, low-power instruments released by a ballistic missile can sense nose effects such as heat or hot air or debris falling.
- Multiple warheads. Instead of single warhead, one nose can release a number of smaller nuclear warheads. This would require defense system to track down each of the smaller warheads. If conventional defense interceptors are used, it would require, nose, missiles and warheads, then no can afford to expand.

"We need to know a great deal more than we do about a great many complicated and difficult things before we will be ready to develop a much better defense system," Dr. Holbrook said, and this is an objective of ARPA's program. Examples cited include:

- Research priority. How do different kinds of ballistic behavior upon impact?
- Kill mechanisms. More knowledge is needed on the lethal effects of nuclear warheads on the upper atmosphere.
- New detection techniques. More investigations are needed to determine effectiveness of other detection techniques, such as infrared, low frequency radar waves.

The list of unknowns is a very long one, Dr. Holbrook said, and filled with critical questions, whose answers can only be obtained by a coordinated research program.

Scientists are trying to obtain some of the answers by observing our own ballistic missiles during launch, and course flight and recovery, using a variety of color infrared cameras, detectors and other test systems. Dr. Holbrook said, "Everything is interesting and involving, costly money. To do everything correctly, which might be worthwhile would cost more money than we have

this year for the whole program." ARPA has engaged a panel of professional people to consider evaluate and recommend which of the average investigations should be given highest priority. Senior project manager priorities to projects in other areas.

Cessna May Merge With Aircraft Radio

Directors of Cessna Aircraft Co. and Aircraft Radio Corp. have agreed to merge the two companies pending approval of stockholders. Agreement already calls for Cessna to exchange two shares of its stock for three of ARAC's—the latter has approximately 212,000 shares outstanding, that some 22,000 shares of ARAC would be involved in the transaction.

Stock swap would not take place at least until after Cessna makes payment of a recently noted 10% stock dividend issued to holders of its regular 40 cents per share common stock. That stock will be issued Dec. 15 to holders of record Nov. 10, the cash dividend will be paid Nov. 17 to holders of record at that time. Aircraft Radio will be operated as a division of Cessna.

Aircraft Radio's sales for fiscal 1958 will be approximately \$12 million, compared with some \$10 million in 1957. Approximately 60% of its business is commercial equipment for business and airline aircraft. When new expansion is completed it will have approximately 164,000 sq. ft. of engineering and production area at its Benton, N. J., location that currently occupies 75,000 sq. ft.

Estimated Cessna sales for fiscal 1958 are \$60 million, a 25% gain over 1957, with substantial recent sales in excess of \$10 million over last year's total of \$12,450,475 and related business being up from \$12,470,175 in 1957 to approximately \$15,450,475 for fiscal 1958. Sales from brokerage management in its national products division were approximately \$1,940,000 compared with \$1,870,000 in 1957.

Pre-Packaged Liquid Rocket

Eastern Marine Division of Theodor Chemical Corp. has developed and successfully fired a pre-packaged liquid propellant rocket engine at 50,000 ft. level. Currently, the company has Navy contracts for the production of Cassin I and development of other rockets. In the past, most pre-packaged liquid propellant powerplants of only 5,000 and 10,000 lb thrust capacity. Successful firing of the large engine is considered a major development, which opens the door theoretically to pre-packaged powerplants of unlimited size.

Navy Warfare Simulator Trains Officers

By James A. Faza



UMFIRE AREA of the Navy Electronic Warfare Simulator projects problem doctrine and weapons around 15 ft. Flighter control plot areas which provide a composite picture of the movements and intentions of the simulated forces to assist in characterizing and evaluating the problem as progress. Weapons target status displays for each of the opposing sides are to the left and right of the screen. Equipment consoles on the main floor are communication console, problem control interface, plot control console, and simulated radio reports.



TYPICAL COMMAND CENTER, one of 28 used as part of the Navy Electronic Warfare Simulator, simulates a flag plot, and command control interface center, all connected center or command tactical center of any or all assigned forces on a table which the command console and evaluates the battle situation and resources command. Facilities include simulated radio consoles, the control panel, force status control panel, target information panel, problem control panel, status board, vertical plot, dead reckoning table, teletype and radio telephone.

Newport, R. I.—Officers students at training the Naval War College here are being trained to make the complex, conventional decisions of modern nuclear warfare by means of a highly realistic Navy Electronic Warfare Simulator that simulates into operations last week.

The object of the simulator is to provide a two-sided war game using electro-mechanical techniques to obtain the elements of mobility, line power and intelligence on which opposing sides maneuver to exercise their skill and judgment in employing their assigned forces in and out.

The simulator has been under development since 1945, the cost is estimated to be about \$2.5 million. It occupies a building a block long and three stories high. In addition to rooms housing a combination radio-digital computer and related electronics equipment, the installation consists of 20 Command Center and an amplifier for engines and operators.

Each commander, his staff, and associated support elements are located in the 20 command center provided for each side. The command center includes a flag plot, a command console, an air tactical control center. From his flag plot, a commander observes and evaluates the battle situation as it develops, exercises control of his assigned forces, and tests the soundness of his battle plan.

The operators, each with professional experience in the type of operation he supports, are located in the UMFIRE Area, an auditorium-type of room which includes the equipment to enable the problem director and engineers to observe and evaluate the operation. Optical projectors project images of each simulated force on a 15 ft. meter plot area which provides a composite picture of the forces and their movements and intentions.

The results of these interactions in the war game program are determined by the support, control by a combination of radio-digital computer which stores weapon characteristics and target damage data. The computer determines hit probabilities, based on weapon characteristics and range to target, and computes structural damage per hit based on target vulnerability to the weapon being used.

Based on these solutions, the computer computes structural damage and vulnerability determines a reduction of the target force when appropriate. A decision by an engine can be inserted manually to eliminate add or



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New Aircraft Broker Purchases 25 DC-7s

Washington—New life is being injected into the mid-plane market as a result of plans reported by two air craft dealers including a conversion to the sector, to buy substantial numbers of passenger aircraft from airlines as they are replaced by jets.

Both companies already have completed major transactions in which they will acquire 57 two-and four-engine planes from the airlines within the next few months. At the same time, both will have transactions with only the beginning of extensive program to buy equipment for sale or lease.

New firm on the scene is the General Aircraft and Leasing Co. Inc., with headquarters in Washington, a newly organized firm to be headed by Milton W. Arnold who resigned as vice president-engineering of the Air Transport Assn. (AWA No. 5, p. 25). Other is Frederick B. Ayer & Associates of New York, an established dealer.

Arnold and his company, as its first transaction, will buy 25 Douglas DC-7s from American Airlines, with delivery beginning Jan. 1. The aircraft will be for sale or lease, Arnold said. Arnold said last week that his firm was engaged to buy, sell, lease and otherwise deal in civil and new aircraft, aircraft engines and equipment.

Ayer & Associates, who earlier announced the purchase of 24 Goetts 240s from American Airlines (AW Sept. 23, p. 17), reported last week that it had purchased two Douglas DC-6Bs from Continental Airlines for delivery within the next few months and it is the market for a substantial number of others. The firm also has reported an Goetts 240s through the purchase of the Danville Corp.

Irish Airline Plans New European Routes

Luxembourg—Air Lingus plans three new continental routes for next year. Subsequent to government approval, the airline will operate from Dublin to Lisbon via London, to Copenhagen via Manchester and Düsseldorf, and to Rome via Paris and Zurich.

The main competition for the Manxman/Zeebe route, the Irish airline will terminate its present Dublin-Manchester-Zeebe-Rome service at Zurich next year. The Dublin-London-Berlin route and Dublin-London-Rome service will be maintained.

Fast deliveries of seven Fokker Friendship aircraft will begin next month to replace company's Douglas DC-3s on services between Ireland and Britain.

COCKPIT VIEWPOINT

By Capt. R. C. Robson



The Control Battle

According to numerous letters to the Editor printed recently in Aviation Week, we are in the midst of another sea of trouble, IFR VFR (positive versus no-visual) issue. As we have enough trouble on our hands without fighting each other. Fact is that at the present time there is no answer. Depending on conditions, we must use coordination ranging from 100% VFR, through 10:50 to 100% IFR in order to achieve maximum safety (Jot).

Since most radar collisions have occurred during VFR weather there has actually been considerable experience for a 100% IFR system. As a matter of fact, there is little opposition to this. The problem is more a question of "if." That is, if 100% IFR could be put into effect, would it be the required airborne equipment could be put into all aircraft, and if there would not be excessive traffic delays, etc. When these "ifs" can be satisfied we will probably find 100% support for 100% IFR.

"See or be Seen" Dependency

How much can we do for VFR? Unfortunately, a great deal. If all nightbirds were painted black the collision rate would no doubt go up (if anybody would take to the air, that is). Recent experiments to render aircraft more conspicuous by the use of "shocking pink" paint apparently have paid. On the other hand, numerous more high schools divide the risk of depending too heavily on "see or be seen." In terminal areas, for instance, aircraft can and do, report their position with great accuracy (i.e. "Over Yankee Stadium," etc.) This knowledge along with altitude should allow one to pinpoint the aircraft with ease. Yet pilot after pilot reports no sign of the ship despite concentrated staring. It is enough that aircraft are difficult to see.

Then also tends to affirm the premise that larger standards would be the answer. Actually too much gain creates other problems—some of which are rather easy to live with.

After the last order most the editors report in the Washington, D.C., area was "let IFR." The limitations of IFR can become apparent when the rules seem to be broken. In fact, the rules of IFR are not broken. Obviously it was a question of VFR or not at all.

There is, of course, some improvement in traffic control in the past few years. It is difficult to see exactly where this improvement has occurred since the system as traffic constantly requires modification. Such things as ALPA's Collision Avoidance and the recent CAA positive control planning have been steps in the right direction. Trouble is that we are no longer able to patch and piece the old system—we need a new method.

Limited Knowledge

Some of the confusion over the proper controls for the new system from our tendency to trust from a limited knowledge, and to judge, too quickly, the ideas of others. All pilots do have certain things in common and yet different types of flying require emphasis in different places. The pilot of small aircraft has a lack of equipment to control with the cockpit, as besides lack of equipment of first class push back into her "home and baggage" flying, and the airline pilot must contend with the demands of multi-engine aircraft systems.

These various chaotic inevitably produce differences in outlook and tag systems for use. Until a miracle comes to give us will have to use all possible wits and means to avoid collisions in the air. And of these means, the most important of all might be termed the common sense, that experience of result.



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SHORTLINES

► **Air Line Dispatchers Assn.** elected Capital Airlines dispatcher Robert T. Conner as a full-time president of the group at its recent San Francisco convention. Conner, who will take a two-year leave of absence from Capital, was selected from a field of 21 candidates. Sam Kusan, also a Capital dispatcher, was selected to the office of part-time secretary-treasurer.

► **Boeing Overseas Airways Corp.** has put its various scheduled routes effecting daily Boeing 747s on Nov. 14, the Boeing 747 Carrier 4 service from New York to London. The airline says the Carrier 4 will take over the company's "Meridian" service, replacing Boeing 747s. The Boeing 747 will be used on regular first-class and common flights. 80AC will also operate on Douglas DC-7Cs on its New York-Boston-Oxford-Kingman route on a four flights per week basis.

► **Eastern Air Lines'** board of directors has deferred the vote's fourth regular quarterly cash dividend of 25 cents a share, and the additional annual dividend of 25¢ in stock, both payable Dec. 15, to shareholders in record as of Nov. 14.

► **Lockheed Air Service Inc.** has received a final price per service contract for work on three Douglas DC-4 aircraft presently assigned to passenger and cargo operations on California Executive Airlines in the U.S. and the Far East.

► **KLM Royal Dutch Airlines** opened its first link in a round-the-world service Nov. 1 with the inaugural flight from Amsterdam to Tokyo on the Polar Route. The Dutch carrier plans to operate the new route on a twice weekly basis during the following winter. Later in Amsterdam for Anchorage for a fuel stop, continuing to Tokyo via Bush, New Guinea, and returning to Amsterdam along the same route. KLM is using Douglas DC-7C aircraft on the flight.

► **Southern Airways** reports first three quarters earnings before taxes of \$112,000. After income taxes, the airline had a net profit of \$61,000, or 25 cents per share on 212,430 shares of common stock outstanding. Southern President Frank W. Hake says that the favorable earnings were the result of advances in mail rates approved by the Civil Aeronautics Board. The current year would be the sixth consecutive profitable year for Southern.

AIRLINE OBSERVER

► **Civil Aeronautics Board** is facing renewed criticism from foreign flag carriers who complain that the Board is the sole major government agency that has failed to recognize the economic relationship of management decisions to the profitable performance of jet transports. European representatives of international airlines claim industry growth is being hampered by CAB action to accept trends in traffic set by national governments of air transportation.

► **General Services Administration**, which controls the purse strings for airline agency traveling, is emerging as a powerful opponent in airline demands for increased fares in the General Passenger Fare Investigation. GSA objected to the 5-6% increase granted in February and said it cost the agency \$855,000 more a year in travel fees. The Department of Defense 54 million. Each 1% increase costs GSA \$130,000 annually, the agency said in a letter to CAB chairman Ralph Abner. Any general fare increase, it added, should be awarded only as a "last resort."

► **First scheduled Fairchild F-27** tailspin transport accident will be investigated on Nov. 14 by Piedmont Airlines. The local service carrier will place its first Fairchild on a route serving Wilmington, Board, Lexington, Greenville, Greenville, Raleigh, and Wilmington, N. C.

► **Russian** has suspended Tu-104A jet service on its 2,175 mi. route between Moscow and the Central Asian city of Almaty near the Chinese border. The Tupolev Tu-104s make the flight in 4 hr., 28 min., as compared with an estimated 25 hr. for piston engine D14s.

► **Addition of new four-engine equipment** under the U.S. airline fleet total to 3,564 aircraft as of last Jan. 1, according to the Civil Aeronautics Administration. CAA also reported a total of 67,151 active aircraft registered as compared with 64,635 for the previous year.

► **TI Al** based Airlines expects to achieve a profit this year after suffering heavy losses in 1977. Last year's losses were attributed to the introductory costs of the British Airways and a decline in traffic caused by the Near East boycott.

► **Most foreign flag carriers** now support the principle of continuous heating of fuel at the fuel system filter of turbine engines as the best possible solution to filter clogging.

► **Wish for Air Line Pilots Assn.** to be dropped from the International Transport Workers Federation. Top IATA officials fear the ALPA threat demanding a third pilot jet transport in the flight deck's position could lead to union ridding by the pilots' organization. They have given ALPA until Dec. 12 to change its mind, or the union will be forced out of the federation. They charge that ALPA's stand violates an agreement signed with ITMW two years ago providing that no crew member shall be assigned into another union membership without prior approval of both labor organizations.

► **Public demand for jet flight** has increased remarkably requests for Pan American in an estimated 33.8% for the Oct. 26-31 period as compared with the same period last year. The carrier reports that load factors on its daily nonstop Boeing 707 flight to Paris increased in excess of 90% during this period, with the highest load factors recorded on weekend return flights.

► **Look for dropped up battle against domestic and international strikes** by their travel agents on matters of rates of commission, double-time elevator operations and use of credit cards. American Society of Travel Agents is prepared to meet its fight against the commission system itself if necessary. International Air Transport Assn. severely rejects ASATA's request for increased commissions and Air Transport Assn. is still studying a similar request. Good travel agent/airline relationship is important in developing the new business needed to fill the ballooning fleets of jet transports.

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Sealing Results in Black Knight Changes

By John Tustall

London-Sealing problems forced extensive fabrication changes during development of the Black Knight, Avrocar-Warner derived from Charles E. Tustall, chief test engineer, during a recent tour of the High Down, Isle of Wight, test site.

Avrocar has integral fuel tanks and is pressurized with air. The main air frames used for structural testing had 16 external bowler hat strainers riveted to the skin. Struts and strainers were wrapped around external bay frames and closed and sealed with a single longitudinal bolted joint. Many seal ring components were tied but all loaded to allow this a period under load, creating a leak hazard.

Method now used is to stitch weld external frames to the skin, fabricate cylindrical sections which are butt welded together. Strainers are machined internal and have been taken inside and welded to the skin. Because of the very thin skin used (23.24 S.W.G.) and the relatively large diameter of the cylinders, a special welding machine was developed for the operation.

The structural efficiency of the Black Knight (AW Sept. 22, p. 30) owes much to the use of external pressure loading. Turbulent stresses developed pneumatically seal the nose of the nose cone and help stabilize the skin under external loading in flight. But Avrocar-Warner was told that the differential pressure used and method of applying it will result among the more closely packed nozzles of the vehicle.

The closed is a method of maintaining differential pressure as the vehicle fills and coexists. During one phase the vessel blows off and at another, internal pressure is probably boosted from a small compressed air supply.

Although the evident need in the Black Knight has not been officially revealed, little attempt is made to control the use of HTP (high test pressure) at the site. A steering hot water tank had open on the ground between the two test gates was to help people "take an unconscious dose" of contaminated with HTP. Avrocar-Warner learned it had badly been thought that liquid oxygen was the coolant used because of the association of both designers and manufacturers of the Black Knight's rocket motor—Royal Aircraft Establishment, Wootton and Armstrong-Whitworth.



FAIRBANKS state test stand (above) used in Avrocar-Warner Black Knight development program at High Down, Isle of Wight, test site. Test vehicle stands are brought in on transporters, moved outside test stand and moved into position by overhead beam crane. Flame deflector gate direct exhaust blast toward the sea. Blasthouse for both stands is dug into hillside behind them and is part visible (right center). Thicker of concentrated hydrogens present, Black Knight outside, is partially covered by hill at left. Size and layout of test stand limit its possible use for you-like checking of complete Black Knight launch (AW Sept. 15, p. 10). Below, on early Black Knight stand a third into the test gate. Structure was changed to the production version to overcome sealing difficulties.



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delic. Motion equivalent — with linear and linear output range development in linear.

Motion is the Black Knight on each mounted on a simple transducer using air driven transducer.

The design was committed to the separate motion below. Paul L. Lusk, chief design development engineer, took over.

He told Aviation Week that the new attraction of the transducer included the relatively high rate of development of the basic engine and motion units used.

Another reason was the fact that the transducer (motion) units was a much simpler mechanical proposition than the general mounted unit needed with a single motor.

No special features are mentioned in connection with the Black Knight rocket motion the figure of which has been carefully estimated at about 4,000 lb each.

Range Increase Attempts

Lusk and attempts to increase the range of Black Knight depended on weight/weight of both structure and motion rather than on increased load capacity.

He stated that only slight modifications had been made, based on the results of the first firing, but he said he could not forecast when the second firing would take place.

The test unit was developed at very low cost because of its being used on this test growth facilitated evaluation operation and because the unit had previously served as a calibration unit and possessed a network of water pressure passages.

Cooking water problems were also simplified as the first sample changes done the first side into the air.

General Installation

Center installation was formerly the way it force used at the firing range. Radar is supported on a simple rubber structure from a single ball and rubber joint.

Control observation blockhouse is equipped with periscopes, located on the linear axis of each unit, and with accurate controls as the extent of a run firing.

Waterproof head up with screen below in the engine box are supplied from the blockhouse.

Fast program is set up as a "Sonic block" and a motorized computer. Instruments in a large conventional rack the recording room provide facilities for up to 250 channels. Equipment includes photographic oscilloscopes and magnetic tape recorder. Facilities of 20-channel remote galvanometer are used for recording higher frequency responses.

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• FLYING SUBMARINE?

Aeronaut engineers and laboratory test group refer to 47 Series **analog** connectors as "flying interconnects." It started as only a humorous name but it is actually a quite accurate description of these connectors. Here's why. The performance conditions under which **analog** connectors will operate are exactly like those of a submerged submarine—flying at 30,000 feet altitude.

Another description for "flying submarine" is altitude-manoeuvre resistance. Under a new test devised by industry and the military, wind **analog**'s are completely submerged in salt water and altitude cycled to 30,000 feet for one minute, to 10,000 feet for one half hour and then returned to ambient pressure for another half hour.

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Space Biological Research Tests Need Instrument Improvement

By Craig Lewis

San Antonio—(and) with limitations in size, weight and available techniques, medical electronics specialists are working hard to improve the instruments used to measure the physiological condition of space travelers.

In spite of some recent developments, the state of the art in instrumentation for biological research on both man and the lower animals in isolated environments is fairly mediocre. New designs will have to appear before medical researchers will be able to do an efficient and complete job of measuring the biological factors involved in submarine, balloon capsule and space vehicle operations.

Requirements vary with the race of the animal being studied in isolation and the stresses it will experience. But the rapidly advancing need for efficient advanced instrumentation is evident from the approaching flights of the X-15 and from the plans of both the Air Force and the Navy to develop equipment that can put animals and later man, into orbit.

Actually, man and animals have already gone into space in the lead of cramped quarters that could make good use of lighter, smaller, more efficient biological instrumentation. Man High and Stratoshot balloon flights have carried men to altitudes whose measurement of their physiological condition was vital. The dog in *Soyuznik II* and the man in the *Thor-Air* now come next as prime subjects for biological study.



GRYDEN SINGER developed by Dr. James H. Merrill of the USAF School of Aeronautics Medicine is shown attached to a meter. The system will be about 11 in. x 2 in. It allows a simple, small lightweight means of measuring oxygen partial pressure in a space ship or even after orbital immersion.

For a small animal like a mouse, researchers have to take many care in experimental data to give its condition. A mouse is too small to hook much instrumentation on, and the preferred heat is possible in electrocardiogram signal to get the heart rate. With larger animals, more measurements are possible.

The trade of measurement biological scientists want to take directly can somewhat offset the specific experiment, but generally there are no order of process, heart rate, rate and depth of respiration, blood pressure, body temperature, oxygen partial pressure at the inspired air and carbon dioxide partial pressure of the expired air.

Other measurements researchers want are the electroencephalogram and electrocardiogram, and oxygen tension of the blood. It would be useful to have television films of the subject which he went a work, which would observe his heart reactions to space conditions.

Essential Measurements

Essential measurements considered controls are taken temperature, total pressure, oxygen and carbon dioxide partial pressure and the oxygen tension profile. Measuring humidity is also valuable because of its effect on the temperature of the subject.

Instrumentation for these various mental measurements is not as big a problem because engineers measure most of these things in animal subjects and tests, and the equipment already exists. Engineers would not be measuring animal isolation levels, however, and a detector of the same general type used in the Explorer satellite will be needed.

The basic problem is in the field of instrumentation for measurements taken directly from the isolated subject to the ground above they can be read as recorded. The telemetry itself is fairly standard, and the data processing equipment is standard. The problem lies largely in developing means to take the measurements on the body and send the signals to the teletransmission gear for transmission to the ground.

NASA has been working on the problem of teletransmission physiological data for several years and has developed a capability for teletransmission several types of this information. With the expanded interest in space flight in the past year the tempo of research in this field has picked up at many laboratories, including the USAF School of Aeronautics Medicine here at Randolph AFB. Work continues under way at the

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in a
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GRYDEN SINGER has developed a small, lightweight, and accurate bio-recorder for use in space flight. The recorder is small enough to be carried in a space ship or even after orbital immersion.

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AVIATION WEEK, November 18, 1958

school is described as "adding known techniques to medical use." In Capt. Rex W. Ware of the Department of Physiology, Biophysics. Researchers are working basically in developing sensors which can translate physiological signals into usable information signals according to Ware.

Oxygen Sensor

New design developed here by Dr. James R. Neville is a marked improvement in equipment for measuring oxygen partial pressure. It is a very small, light oxygen sensor which operates on polarographic principle, and in certain applications it will replace much larger and heavier equipment now used.

The new sensor is a cathode cell which has a gold working electrode with a polystyrene membrane over it to insulate a thin film layer of silver chloride. Oxygen diffuses through the membrane and is chemically reduced where it hits the gold electrode. Because of electrochemical reaction, current flow is produced from the gold electrode to a silver electrode which is directly proportional to the partial pressure of the oxygen in the ambient air.

Oxygen sensor requires no external electric power to operate in because the oxygen is spontaneously reduced. A suitable output amplifier is installed across the two electrodes and the amplifier is fed into a measuring device. Signal can be fed directly into telemetry recording equipment. Output ranges up to about 200 millivolts per percent oxygen. The sensor operates in an oxygen concentration of 0.2 to 20 percent. A patent application has been filed on the new sensor.

The sensor provides a transparent film of constant oxygen partial pressure in extreme environments and conditions. One model is about 2 in. and extremely light and other models are the same general size. A small version has operated for two weeks and larger ones are expected to last much longer. The sensor can measure oxygen in air, but it is also small enough to fit into a mask, a stove and measure directly the oxygen content in the air going into the space that's being heated.

Carbon Dioxide Sensor

A closely allied problem is the development of a carbon dioxide sensor to replace the bulky infrared absorption system whose weight and space limitations are of paramount importance. Dr. Neville is working on a device, in the same size and weight class as his oxygen sensor, an operational instrument has not yet been perfected.

Measurement of the rate and depth of the space transfer's breathing can now be done with a respiratory volume sensor that is an adaptation of a non-manually available device. Using a

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deftly on the blood vessel and continuously recording cell pressure and microphone signals gives a blood pressure reading.

Heart rate is a legend of the system, as it is of other physiological measurements, the same type of electrolyte pickup and in the plethysmograph is employed. Leads have to be placed carefully to avoid getting signals from muscle masses in a moving subject and the top and bottom of the chest from the heart physical parts. The electrocardiogram has usually been recorded in flight.

A method for investigating peripheral circulation in the body is under development by Dr. Samuel H. Parnis, Jr., at Albany Medical College, N. Y., under USAF contract. Dr. Parnis electronic Doppler plethysmograph measures changes in volume of a zone of tissue between two electrodes-but in practice, the area between the electrodes and walls.

This instrument permits study of circulation and blood flow in the legs, and replaces the cumbersome water displacement technique.



Dervish Missile

First view of Northrop 275 ft. Dervish missile was recently developed in replacement for the Mighty Mouse air-to-air missile, thus prepared in time for ground-to-air use. One railhead Dervish is powered by solid fuel TRX 1608 Thiol rocket motor.

Missile Site Plumbing Gets Special Cleaning

Ultra-hygienic process in the chemical and cleaning industries are being used by Dowell Division of Dow Chemical Co. to clean the intricate plumbing of missile launching complexes.

Dowell cleans tubing and other sections in the missile pads and launching complexes when they are first constructed, and before the systems are even engaged in the system when they are modified.

Cleaning jobs must meet close specifications set by the military agencies operating the missile facilities. Dowell must meet standards of 15 inches on outside size, and that hydroblasting there must be no maintenance under 3,500 psi of water.

Some parts of the launch pad plumbing can be dismantled and cleaned by cleaning in situ, but other parts must be cleaned in place. Dowell uses acids, caustics, degrading solutions and solvents for this job, saving the cleaning agent with the different metals being cleaned.

As a result of its missile facility work, so far, Dowell is regarding the use of welded piping in the missile to make



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the cleaning job simpler. Welded pipe is manufactured because it provides better sealing and there are no joints in the pipe joints to collect contaminants.

Dowell also has a Dow-developed anti-corrosive additive for use with its solvent materials.

For the cleaning job at the Air Force facility at Cape Canaveral, Dowell designed special tracks with stations that support and speed filters. Most of the tracks will have special cleaning gear levels mobility to the system.

In addition to the work at Cape Canaveral, Dowell has done similar work for the Martin Co. at Denver and will clean the launch pads at the new HCBM base at Wallops Island, Va. Waco Company also does chemical cleaning for the Army at Redstone Arsenal and is working on the first Bantex installation in Florida.

Survival Influences Polaris Performance

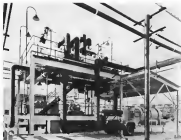
New London, Conn.-based Missile Systems Division has found that factors affecting human survival under prolonged submerged cruise conditions are directly influencing weapons design of Navy's Polaris fleet ballistic missile.

It was discovered early in Polaris development that certain materials which might be innocuous to humans over a short period of time could become potentially toxic air pollutants when inhaled for prolonged periods. More generally, the emphasis pointed out that man and his ability to survive in the hostile environment he will encounter under the sea and in outer space will be the limiting factor in the development of the advanced submarine air space vehicles of the future. It was also predicted that man's basic performance limitations could either more advanced vehicle programs be a case at some-and perhaps influence the basic design of the vehicle.

It was disclosed that certain factors of human survival, with which human engineering research is concerned, may offer appreciable a vehicle system which the company previously had in its design bench.

Nuclear Engine Shielding Studied by Boston Group

Development of materials able to contain nuclear engines operating at temperatures up to 5,000°F will be an urgent project of Nuclear Metals, Inc., in its new facility at Boston, Mass. Company also will investigate uses of lighter, non-toxic, non-radioactive and non-flammable at 52 million Metallurgical and Development Laboratory.



Gases from Ethyl Chemical Corp. are piped here from still rooms. After it is purified and liquefied through refrigeration with liquid nitrogen, then loaded in tank trucks.



Fluorine is produced electrolytically in cell rooms through the reaction of hydrogen and fluorine from hydrofluoric acid. Allied plant includes several rows of fluorine cells like this.



This is the exterior of part of Ethyl Chemical Corp. General Chemical Division's Nitropar plant (R) Works Boston plant. Another process equipment is shown here.



Benzene and other raw materials are converted at Colby into an intermediate chemical in first step of HCBM production.

Plants Begin High-Energy Propellant Production

Allied Chemical Corp. and Colby Chemical Co. have begun large-scale production of high-energy propellants. Production of liquid fluorine at Allied Chemical's General Chemical Division plant at Metropola, Ill., is the first step in production of UF₄ for a U.S. Atomic Energy Commission program, through refining of uranium oxide compounds. Capabilities sufficient to also supply foreign quantities for rocket and missile use, according to Allied Fluorine is delivered in both gas and liquid form in tank trucks. Tank truck units equipped with inner tanks which contain insulating aerogels. Fluorine in the innermost tank is cooled below its -186°F boiling point to keep it in a liquid state (N.Y. Press, 24 p. 45). Rocket engine research has utilized fluorine in an effort to produce an oxidizer with an extremely high specific impulse. Colby Chemical Co. has built a \$25 million high-energy fuel plant for the Navy which will produce large quantities of brown-based fuel over time. This fuel called HCBM will be used extensively by the Navy in submersible and transport propulsion tests which are expected to be the most powerful and productive ones for the fuel, according to the company. Fuel is bottled in Metropola, Ill.



Two cylinders are shown at low pressure in Colby Chemical Co. sphere at left, gas carbon dioxide is mixed at low pressure in right sphere. Tower in center separates the gases.

from any point of view

CON

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WIDE-TRAIL large-diameter steel landing gear provides McDonnell 120 with large "footprint" for operating off soft, uneven terrain.

Three-Turbine McDonnell 120 Shows

By Edwin J. Bellon

FT. BELTON, Va.—Triple turbine-powered lightweight McDonnell Model 120 helicopter is shown at present-day Army ground troops in basic area with a versatile low-temperature flying crane having a maximum weight load to eight weight units of 1,500 while also featuring engine start.

Quick, power and rapid climb, demonstrated here recently by McDonnell, had the Model 120 off the ground in less than 14 sec. after the pilot engaged the first of the three engine starting switches and he climbed vertically at an estimated 1,500 fpm, while carrying a 1,600-lb. 75-ton. hoist and slung under the landing. Without a crane load, the 120 has a climb rate of more than 1,500 fpm. At the maximum of the demonstration, the pilot took off and climbed vertically at two stages at a rate of about 1,000 fpm.

Model 120 can carry approximately a ton over 50 mph at a cruise speed of more than 150 mph. Close configuration, which underneath, also provides a low silhouette to the enemy, permits rapid attachment of bulky items such as a 105 mm. mortar or a prop-type vehicle while the aircraft



NARROW landing gear gives good visibility.

Crane Ability

is on the ground. Location of cargo hook under the rotor hub minimizes risk of ground-based accidents.

Variety of loads covered by McDonnell engineers includes various configurations of pods and personnel litters consisting of two bag "infantry-type" litters capable of holding 11 men with Pegasus slings to protect occupants from rotor downwash and moral blast.

As a tactical weapon carrier, the offensive action against ground troops, the Model 120 is capable of being fitted with 96 2-in. rockets or 40 2.75-in. rockets clustered in tube launchers.

McDonnell is not overlooking possible Navy shipboard applications, the company points out that Model 120 is capable of operation even under high winds—some rotor configurations have been started and stopped in wind down to 300 kt. Model 120 maximum length, 29 ft.; height, 9 ft.; rotor diameter, 31 ft.; landing gear steel track, 9 ft. 2 in.

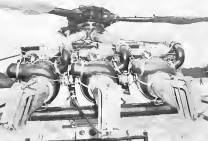
For use in aircraft mode for fighting, the small crane can carry a 6-in. Lighter, a medical attendant, 200 gal. of fuel under operating pressure of 300 psi and a crash safety kit. Four litter patients may be carried on external trip from the tower. In ground fire fighting, such as forest blazes, the



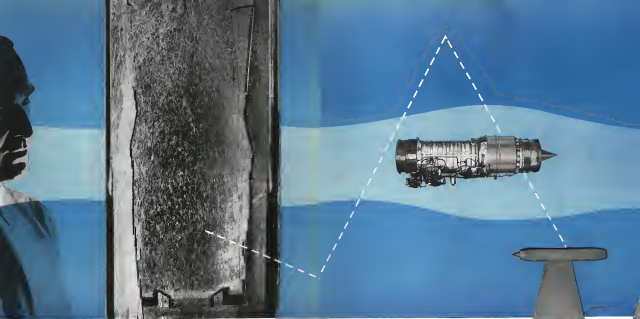
CRANE CAPABILITY is demonstrated (above) by pilot Joe Edwards lifting 75-ton. hoist weighing 1,750 lb. at approximately 1,500 fpm. Cranes are used to lift more ground load, mg. of bulky loads. Endless roll, added more wind loads (AVF Aug. 11, p. 24) to improve directional stability and control.



DOWNDRAFT exhaust deflector (above) on each engine or linked to roller pods and rollers (right) to ensure positive control even when helicopter is hovering with heavy load in air. Note linkage stop roller, on deflector.



DUCTS from triple Allison turbo-compound engines feed 350° air to rotor, intensifying rotating airfoil blades. Engine exhaust period is temporarily cut at 500 ft.



Westinghouse proves jet combustion efficiency

This plastic combustor model enables Westinghouse engineers to predetermine combustion efficiencies in turbine designs. Observations of the flow of the colored water and air bubble mixtures permit visual evaluation of air flow patterns in normally unobservable areas of engines. This test method minimizes trial and error testing with handmade metal prototypes.

Development of the latest J34 configuration for use in North American Aviation's T34 trainer proved the value of this water flow analogy test

rig when design modifications to permit the use of J45 and J46 or J47 were quickly and accurately evaluated. This is just one of the many complete facilities for research, design, development, testing and production of jet engines at the Aviation Gas Turbine Division, Westinghouse Electric Corporation, Box 588, Kansas City, Missouri.

AVIATION

YOU CAN BE **SURE** ... IF IT'S Westinghouse

Bounce one off the moon

It wasn't very long ago when space engineers weren't equipped to bounce a missile off the face of the moon. Today, they're thinking far beyond this near frontier of outer space.

Just as Ex-Cell-O rocket and missile components help put missilemen within shooting distance of the moon, so will Ex-Cell-O products play a pioneering role in conquering other outposts of the universe. Ex-Cell-O also supplies fuel nozzles, blades, rotors, valves, actuators, fuel controls, parts and assemblies for jet aircraft and missiles.

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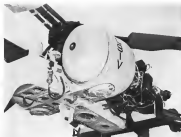
Aircraft Division

MAN AND MISSILE FLEET: PARTS AND ASSEMBLIES OF EX-CELL-O



EX-CELL-O FOR PRECISION

48-22



FUSelage controllable landing aircraft, showing 4,500-lb. empty weight. McDonnell Corp. built, part 300 gal. 37 1/2 fuel tank and a dry weight tank (shown with fuel)

Model 120 can carry up to 500 gal. Fuel is carried in a 37 1/2 gal. tank. McDonnell knows there is no easy way to carry fuel in a tank. It expects that as the tank of a drone is used, it will be replaced by a new one. The new one will be replaced by a new one. The new one will be replaced by a new one.

Simple, rugged, lightweight 171 lb. engine the role of a drone. McDonnell knows there is no easy way to carry fuel in a tank. It expects that as the tank of a drone is used, it will be replaced by a new one. The new one will be replaced by a new one.

replacement of any powerplant in 5 min without use of tools. McDonnell engineers point out. Each engine is in a quick disconnect, so mounted for easy access.

Engine is a simple, rugged, lightweight 171 lb. engine the role of a drone. McDonnell knows there is no easy way to carry fuel in a tank. It expects that as the tank of a drone is used, it will be replaced by a new one. The new one will be replaced by a new one.

Instead, the Model 120 was fitted with CYC-55-55 engines, each delivering 125 lb. of air per sec. to the rotor, and with burner nozzles thrusting for hot dry, resulting in 430 lb. total thrust. Currently the prototype has improved CYC-55-121 engines, which have cut engine losses, delivering 140 lb. per sec. of air to the rotor, resulting in total power at the tip of 430 lb. thrust. In the work is installation of a still larger engine, the CYC-55-16 delivering 145 lb. of air per sec. to the rotor and providing a total power from the burner of 655 lb. thrust.

Engine provides 32-13 lb. thrust per engine through the exhaust nozzles for directional control.

Use of precision jet rotors, allowing small for maneuvering, power shafting and fuel rotor, which provide more configuration by permitting legs, "cut out" area in the fuselage from the fuel engine.

Rotor system, of the still all-steel blade and pitch-control coupling type, was lifted directly from McDonnell XV-1 configuration signals, changed for

NORD CT-20

**Turbo powered
Radio controlled
Target Drone**



Two launched from its own portable trailer, the CT-20 CAN BE EASILY TRANSPORTED AND OPERATED FROM unprepared areas. Recovery is by parachute.

Designed and built to fly like a fighter, the CT-20 offers high performance at low operating cost with a minimum of ground control and support equipment.

PERFORMANCE

Speed (32,560 FT) 560 MPH
Time to 32,560 FT 6 MIN.
Service Ceiling 48,000 FT.

Production is now underway to supply the French Army, Navy and Air Force. It has also been recommended for use by the US 7th Army in Germany.

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USAF. Proven reliability of the system, as pointed out by the company, is shown by the fact that in 750 hr of test operation, the Model has never been tinkered—company does not even have any blade tracking equipment; one representative told Aviation Week & Space News that the Model has these features: chronically all bearings, under constant load (there are only 34 bearings in system); diameter reduced; lubrication requirements not possible without making use of the entire rotor system (compressor furnished as of some 5127 to type).

Helio Blade

As it ducted through hollow blade spots to the turbine, where single generators, utilizing freewheel rectifier, supply fuel for heating. Constant rotor position cost-consistent rotor speed of 400 rpm—should there be a rotation of flow to any of the type other generators would cause drop-off and stress to maintain sufficient fuel flow to maintain rpm, independent.

Water injection system, spray directly into engine intake, is capable of providing sufficient heat to maintain standard day performance at 90°F; power source is equivalent to drawing 500 lb of additional fuel. Water tank, located atop fuselage between fuel tanks, has 7 gal. capacity.

McDonnell 120 Performance Estimates

Propulsion

Three Allison GTC-45-M gas turbine jet engines

gross applying McDonnell static lift thrust*

Fuel capacity (JP-4) 227 gal.

	Gross weight	5,000 ft	6,100 ft
Maximum speed	1,000 mph	1,000 mph	1,000 mph
Cruise speed	1,000 mph	1,000 mph	1,000 mph
Minimum rate of climb (SL)	1,000 ft/min	1,000 ft/min	1,000 ft/min
Vertical rate of climb (SL)	1,000 ft/min	1,000 ft/min	1,000 ft/min
Turning radius, in ground effect, NACA standard	1,000 ft	1,000 ft	1,000 ft
Turning radius, in ground effect, 95%	1,000 ft	1,000 ft	1,000 ft
Turning radius, out of ground effect, NACA standard	1,000 ft	1,000 ft	1,000 ft
Turning radius, out of ground effect, 95%	1,000 ft	1,000 ft	1,000 ft
Range	1,000 mi	1,000 mi	1,000 mi

* Flying prototype now fitted with improved GTC-45-115 engines, further improved GTC-45-16 to be fitted later.

* Gross weight to permit 700 ft/sec level maximum rate of climb with one engine inoperative. * Gross weight to permit 100 ft/sec level maximum rate of climb with one engine inoperative.

The company reports that the latest simplicity of the aircraft makes rapid pilot installation possible. While scanning the Model 118 in the Washington area, McDonnell checked out 17 pilots in two days, on a trip to Quantico, Va., eight pilots were checked

out in 2 1/2 hrs. Extra steering is by means of simple air-actuated controls for each pilot's seat. Basic fuel is JP-4, although gasoline can be used for limited periods of time. Company reports that the present job is not necessary to type of fuel used.

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Electro-Mechanical Equipment—such as the Air Force's ASR-6 Airborne Dead Reckoning Navigator Computer now in production at Hoffman—evaluate gyroscopes, inertial navigation systems and components, sensor/mechanisms, fire control systems and guided missile controls. These are workings of the special Hoffman skills and electro-mechanical capabilities which can help solve your design problems.



Hoffman Laboratory gyro (disassembled) gyro (assembled) for maintenance by Humphrey, Inc.

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gyro, but a short time is saved as the response of five shaft-tachos MFTG is reduced.

Regarding controls, Hyden mentioned:

- Starter control should be operated by a three-position switch: the depressed position should engage a fully retentive starting coil to ground (off, intermediate position would be off, the left position should motor the engine, and the switch should be spring-loaded from the center.
- Governor switch should be a two-position type (manual, emergency) and should be grounded and locked on its emergency (off) or center position.
- Reverser solenoid switch should be a two ("locking") type switch and should be locked in collective pitch control. Also included should be a one-to-one manual clutch lever which immediately provides engine rotation at desired rotor speed which also provides an indication of rpm range which has been selected. Lever would normally be positioned manually or by rotor speed (one switch).
- Made selector should be incorporated in the fuel pump and should have the following positions: governed flight, flight idle, ground idle and cutoff. Frequent check-ride at all positions and visual reference marks should be incorporated as should a guard in form of a positive lock from cutoff position.

Turbine Helicopter Design

Design requirements for turbine (jet) and helicopters were discussed by Mr. W. L. Stevens, Kansas Aircraft Corp., covered such control items as powerplant isolation, type of mounting and reduction systems. Stevens' paper went into the point of accessories for turbine helicopters. General standard accessories for helicopters (turbines) should be located according to engine installation. Stevens noted, adding that a survey of the helicopter industry indicated need for two power (torque) packs—one for instruments, one for the generator. Auxiliary power (torque) for such special purposes as large generator required by electronics is an anti-oscillatory turbine helicopter requires different solutions, Stevens said. Main transmission is often used for this purpose, Stevens said, but this poses problems when power must be used in ground clearance without rotor turning.

Concerning auxiliary power (torque) as ground, Stevens pointed out that for every horsepower extracted from a gas producer action, up to approximately two horsepower is subtracted from the turbine output shaft, a fact which cannot be ignored when mounting auxiliary power extraction during high-power operation of the engine.

Stevens recommended that both on



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PROVING OUT THE IROQUOIS



At the Air Force Flight Test Center, Edwards Air Force Base in California, skilled engineers and test pilots are proving out the Army's Iroquois helicopter in Phase 4 performance and stability testing.

This is just one hurdle in the Army-Air Force obstacle course the Iroquois must pass successfully to merit the Army's acceptance. And since the Iroquois, Bell's HU-1A turbine-powered helicopter, was designed and built to meet the Army's needs for front-line duty, these tests are hard, tough and realistic.

Phase 4 testing, covering the helicopter's entire flight regime, is conducted to substantiate helicopter stability, handling characteristics and performance data. It will verify the HU-1A's ability to meet the particular weapon system requirement. Instrumentation is used extensively throughout the tests to record data, which is reduced to standard conditions, thus eliminating variables from the test results.

And this is true throughout the complete series of tests... the Iroquois is proving its worth... In every phase of performance, supply and transport, weather, maintenance, combat conditions and general military usage. Final approval of the Iroquois will mean that the Army, as always, has the best in fighting equipment.

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CORPORATION

FORT WORTH, TEXAS

SUBSIDIARY OF BELL AIRCRAFT CORPORATION

500 and no cruise below 6,000 ft. have capability, and 100 kt. cruise speed, he said the S-55 can meet the payload and radius parameters but only at a speed of 80 kt. and 4,000 ft. lower. The S-62, however, can meet all requirements with performance to spare.

Holding speed, radius and lower altitude, payload could be added to 950 lb. or holding payload, cruise and lower radius can be increased to 175 knots, or holding other parameters basic altitude can be raised to 7,500 ft.

Watts said that while this indicates progress, there still is much room for improvement. He added that Sikorski is studying installation of burners as other models to take advantage of power dynamic components, realizing that such conversions will take place in suitable powerplants because available.

Two serious problems with downwash on the legs and torso between Sikorski S-65H-37A and S-62B-1) were outlined in paper during the session connected with this problem. Although downwash problems were of primary interest, other aspects of operations with the machine were detailed.

Both papers, one by Army Aviation Board representative Maj. Willie W. Barnes and the other by Lt. Col. A. W. Galt of Marine Corps, indicated that operations over rough or unimproved terrain produced a number of problems.

Primary problem was lack of stability in the pilot due to air being cut and gusts in other manner. A cloud of dust reduces pilot visibility to an extremely marginal condition, and in one of our aircraft or wind shift which means all the small remaining problems disappear, thank to the only recourse. This of course can be hazardous, especially if landing is in progress.

Other problems noticed in ground operations which need more than ordinary protective clothing to deal with the downwash and during landings.

Additionally, fabric damage to uniforms and engine a significant strength to experience of both screws, varying to some extent according to maintenance taken to alleviate the problem. Serious reduction in mission effectiveness had been demonstrated by both due to slipping in fabric in engine, radiator intake. Some more effective reduction also was needed by one service after 50 ft. due to stress from ground heavy debris.

Another problem was static electricity, with resulting voltages as high as 40,000 reported, although no damage was negligible.

SEI, one were involved to the ground when touching the aircraft as it landed during a sling or equipment loading. Means to discharge static are badly needed, both screws indicated.

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15 OCTOBER 1958

Superseding
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CONNECTORS, ELECTRIC, "AM" TYPE

CLASS R - ENVIRONMENTAL RESISTING (light weight) CONNECTORS are a new addition to the M-B line. The M-B-8 supersedes the M-B-6 which has been inactivated for new design.

Cannon is the only qualified source for the complete line of the new class M-B-8 connectors.

"Class R connectors are intended for use where the connector will be subject to heavy condensation and rapid changes in temperature or pressure, and where the connector is subject to very high vibratory conditions."

MIL-C-5015D specifies that Class R connectors shall have "the wire sealing grommets in firm contact against the rear face of the insert." This requirement, now written into the specification, has always been a Cannon design criterion for all M-B environmental resistant designs.

Although the M-B-8 now supersedes the M-B-6 "for new design", Cannon Plug Series M-B-6 (Series M-B) and M-B-7 (Series C-7) will continue to be available.

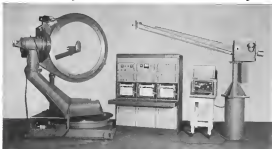
For information on the new M-B-8 Cannon Plugs write for Catalog M-B-8N-A - Refer to Sept. 110.

CANNON PLUGS 

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The effectiveness of the best airborne radar bearing system can be completely designed by definition of the radar beam as it passes through the plastic radome. Now for the first time, radome manufacturers and aircraft firms installing radomes can be completely assured of radome quality. CTI Automatic Radome Through Film Measuring System replicates radome spot drilling with a continuous recording of beam shift inside radome.

In the system shown above, as the sector driven rotating fixture rotates the radome under test, the servo controlled null-seeking antenna on the beam traces the position of the defocused radar beam. At the control console, which provides eight-point control of the entire system, three recorders plot the total magnitude and horizontal and vertical components of the beam deflection angle directly in milliradians. Rate of change of beam deflection essential to missile applications is readily obtainable from the recordings.

Additional features include automatic plotting of antenna patterns with or without the radome and radome transmission efficiency measurements. The system is available in frequencies from S through Ku bands and upward.

Fig. 1000. Costs approx. \$100,000; available at CTI

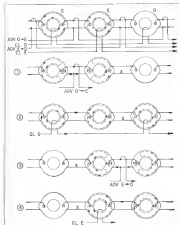
For bearing type and other systems using shaped beam antennas, this beam can be used to measure the null position on it.



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BASIC: shift cycle for a multi-spectrum shift system is designed to indicate the first shift in each of the cones in the beam pattern of the shift cone. The first to be indicated. Multi-spectrum shift system also allows the user to do so with conventional magnetic cone.

results can be reconstructed to permit the bearing. One channel, given the inputs X, Y, can provide an output X and Y, or X, or Y, or Y, and others. Several outputs can be interconnected so as to transfer logical combinations of variables and each of the channels can be individually closed.

To understand the properties of this system in input and output across power, consider the basic element structure. The basic element structure is a two-dimensional structure with the aperture on its wall. The distance between input and output aperture is made as the size that the waveguide taking these apertures are connected into the output.

The accompanying schematic diagram of a basic dual cycle coplanar waveguide device indicates the method of operation. Strongly and weakly of reference is based on a heavy coil, which can shift, of single shift, the waveguide a zero while a second state signals a one.

The reference or zero state for one of these devices is known the "idle" state. The "idle" state is generated when sufficient current is present through a loop of wire surrounding the cone so that the total magnetic flux in the cone is equal to the (in the cone) in a clockwise direction.

The basic cone as "off" state is achieved by passing a current through the loop connecting the input aperture so that magnetic flux from the cone is in the clockwise direction. The basic cone as "on" state is achieved by passing a current through the inner and outer sections of the cone.

An element in the "idle" state is defined as being in the heavy zero state. An element in the "on" state is defined as being in the heavy one state. The input aperture provides further control, support, support, other than the digital setting feature. In an ordinary magnetic cone, a negative magnetic flux following a positive

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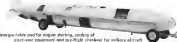


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magnetomotive force tends to reverse, unaccountably, any fire vented by the positive signal. In the anti-repetitive device, a subsequent negative current applied at the input aperture merely reverses the flux locally about the first aperture without affecting the flux state of the output aperture. This dovetailing feature is important in the logic of the basic transfer loop.

With reference to the diagram, the output of the first element is in a low level or "set" state. The action of transferring this value to the next element requires an order in the form of an "advance" pulse. If the output were in the zero state, nothing would happen and a "reset" would be required by default. However, because the output is set and the state of the input and output maps of this shift, the flux about the output aperture switches locally with very little current flux. Inevitably, the output of the element to flow through the input aperture at the following element causing it to go over its setting threshold and become "set." In the flux switching is completed, both elements return to their normal output value.

Clock Cycle

To demonstrate the operation of the anti-repetitive device, shift register, compare it with a conventional two-state per bit register. The elements of a conventional register can be divided arbitrarily into two groups, with an "advance" line being each one of group in series. In this case the object is to shift the stored information from one group of cells to the other each time there is an "advance" pulse.

Using the conventional definition of zero and one as before, transmission of a zero in a definite sense the "advance" pulse causes no flux reaching in a zero output case. However, the "advance" pulse will switch a one stored in one which results in a transfer loop current that matches or "sets" the following cell.

Ideally, no effects of the transient current should be felt in one after the next.

To isolate the transmission effects, conventional register protocols employ a series diode to prevent current from flowing in the following loop in a result of the picking of the signal of the core being "set," and a diode diode is used to prevent backward transmission from the next transferring the signal to the previous core. In this manner, one-way transmission is obtained by the use of unidirectional elements.

Actually, each "advance" pulse has two functions. For example, in "advance" pulse ordering the information stored in one group of cells to be advanced to the second group also leaves the group transferring the information

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in this "clear" state, ready to receive
new information.

Because sending out the information
present at an output aperture of a
multi-aperture element does not destroy
the information state of the element,
the "advance" pulse cannot destroy
newly advanced the stored information
and clear the knowledge as in the con-
ventional non-clock register. Therefore,
as shown in the diagram, a register made
up of multi-aperture elements requires
specific "clear" readings, which results
in the basic four-clock system shown.

Data Transfer

In the diagram, the two groups of
multi-aperture elements are labeled with
Q1 and Q2 and the information
to be transferred is stored in the Q
state. The "advance" pulse (ADV Q
to E) shifts the information to the E
element. The Q element sees three
elements cleared in the "clear" pulse
(CL Q). The ADV E to Q shifts the
information back to the Q element,
and the E element sees three
elements cleared by the CL E signal.

By tracing the details of the data
transmission, it is possible to see how
the multi-aperture elements and the
basic clock cycle work together to yield
error-free transmission. The diagram as-
sumes the transfer of a binary state mac-
chine, as stated above, the transfer of a
word is by default.

The diagram shows indicate the data
received is one leg of the cycle in a
word of a periodic pulse. The ADV Q
to E pulse switches the data stored in
the output aperture of the Q element
and causes the E element to become an
CL Q pulse then clears the Q el-
ement and is in doing transfer data
through the output element. This re-
sults in a loop current flow that "repre-
sents" the E element without af-
fecting the data state of the output
aperture of the E element.

Note that neither the ADV Q to E
nor CL Q pulses cause any flux to be
switched in the output leg of the E
element (indicated by the crosses op-
posite the output winding), changing
the need for the non-advance state
(mode). The order to advance CL Q to Q
shifts the binary one to the next Q
element in the direction of trans-
mission, and the CL E pulse then clears
the E element.

Again, neither the ADV E to Q nor
the CL E pulse cause any flux to be
switched in the input winding of the E
element, changing the need for a
clear state to eliminate backward
transmission.

Because during the cycle there is no
"unwanted" flux that must be dis-
posed slowly in resistance, the transfer
state can be extremely high. For ex-
ample using General Ceramtec S-3 or

Tekneter Magnetics T-3 ferrite with
an information rate of a quarter
megacycle can be achieved—which
means a four-pulse cycle time of less
than one microsecond.

Ordinary transfer rates with multi-
aperture added do not have the opti-
mum quantity to sample shift register
elements. The main disadvantages are
in the switched flux in magnetic cores
force relationships and switching prop-
erties. The major difficulty is that with
apertures out in the well, as wires
have lead the device is cleared, not all
of the material can be left in saturation.
This results in an unwanted reverse element
and hence "noise loop" operation as
part of the core.

Properties Improved

Both of these properties are signif-
icantly improved in the two position
element design at the right of the
accompanying element display photo-
graph which have approximately equal
conventional core inductance. This
first order improvement in storing
yields an element that can be almost
completely saturated in the "clear" state,
with a maximum of momentary reverse
element.

Also shown is the basic "register"
device with a single input and output.
As far as the input aperture is con-
cerned, it is only necessary that in the
"clear" state, the flux in the leg ad-
jacent to the input aperture be purged
so that the element is suitable. In this
condition, any flux switched in the
input will switch through increasing
quantity to the output register.

If the flux were applied "anti-
parallel" then any flux switched in the
input leg would switch locally about
the input aperture without affecting
the output register. This "clear" state
flux requirement holds for all input
apertures of all devices to operate
within data criteria. For a "mag-
netic" device the "clear" state output
aperture requirement is that the flux
in the leg adjacent to the output
aperture should be antiparallel. Under
these conditions, with no input a
binary one will be transmitted.

The extra center leg is provided
only for flux-density purposes, and it
is prevented from having any flux
switched in it by a "lock" winding
coupled order antiparallel to it at the
appropriate pulse times.

With the register device in its
"clear" state, the output "advance"
current pulse will cause a binary one to
be transmitted in the next element. If
previously, the register element was
"set" had received a one, then the
input flux would have blocked the out-
put, resulting in a subsequent trans-
mission of a zero.

The accurately placed dots in the
aperture element are for the present



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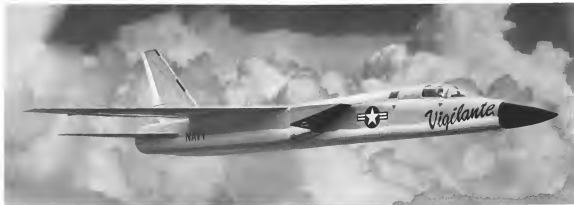
Design and application of poured-in-place foam and aluminum construction is illustrated by this structural and clear test of Craig Model 130 Helicop-Hut® with 1,000 pound payload.

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THE VIGILANTE STORY

A report on the Navy's new manned weapon system, designed to ride herd on brushfire wars...or deter an all-out conflict

Recent events have made it clear that our defense must be built to handle limited warfare as well as full-scale nuclear conflict. The Navy's new carrier-based A3J Vigilante was designed and built by the Columbus Division of North American Aviation to fill this dual role.

HIGH OR LOW

The twin-jet Vigilante is the fastest and highest-flying of the Navy's attack planes. It can fly in the high stratosphere faster than the earth turns beneath it. But apart from being one of the fastest airplanes in the world, Vigilante also handles beautifully at any height and any speed, right down to slow landing approaches for carrier decks or short run-

ways ashore. This is made possible by its advanced boundary layer control system and full-span controllable leading edges.

EYES AND BRAINS

Vigilante can find targets at extended strike ranges, even if they are obscured by the weather. The electromechanical system that gives Vigilante this super-accuracy is the result of a coordinated effort between the Columbus Division and North American's Automatics Division in Downey, California. This precision bombing-navigation system enables the Vigilante to deliver its weapons from any attitude, at any altitude.

ARMED TO THE TEETH

Another reason for Vigilante's versatility is that it was designed to handle the gamut of armaments, including nuclear weapons. But by far the most important "equipment" aboard is the Vigilante's crew of two—pilot and bombardier-navigator. This

is especially true in limited warfare. For only a man can size up a situation...only a man can change his mind if the need arises...only a man can take advantage of an opportunity.

The A3J Vigilante is now in flight test preparatory to joining the fleet.

A NEW CONCEPT IN JET PILOT TRAINING—THE T2J



Key to mission. The T2J's powerplant and auxiliary equipment is placed outside the primary structure. Large, quick-opening doors give ground-level access to the equipment bays. The 2-58 jet engines can be removed in 5 minutes, replaced in 20.



Key to life in flight. The T2J's stall speed is less than 30 knots, yet its top speed is 434 knots and it flies safely at Mach 0.93. The very large tail gives this trainer good stability and positive control at low speeds—for safe landings on carrier decks.

THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.



of eliminating unwanted signals about the output against present or suspected types, so that in the "clear" state constantly all material is on a major frequency loop, thereby providing a significant improvement in threshold properties of the device.

Proper Shopping

From work performed to date, it is clear that in selecting proper shopping strategies, signal functions can be performed directly within the circuit. These techniques can be extended to more complicated functions such as "load" or "release" of a memory, in

designing such elements, the geometrical aspects of both the logical functions and operational purposes must be carefully considered.

Most of the laboratory's efforts thus far have been in developing basic circuit arrangements and understanding the fundamental processes. Although the circuits and elements described have been operated in closed loop configurations, no large scale general logic systems have yet been constructed. These new devices and techniques, however, present interesting possibilities for general application in the digital processing field.

Space Avionics, Propagation Data Dominate Aero-Com Conference

Utica, N. Y.—Professionals of space communications and related propagation phenomena affecting military and aerospace systems gathered for consideration were discussed in technical sessions here at the Fourth National Aero-Com Symposium.

Notable by their absence were papers dealing starting with the ideas of both regions and at the other end of the spectrum—blue sky proposals with little relationship to present or anticipated aerospace projects.

Among the papers of interest were:

- Space communications design. An introduction to space communications system design was presented by L. F. Yeh of Westinghouse Electric Corp., who pointed out some of the unique problems of communicating from earth to space, space to space, and space to earth. Also discussed were repeater satellites and use of the moon as a passive repeater.

- Polar problems. Transmission factors affecting communication between space vehicles and polar locations were discussed by L. W. D. Short and L. G. Keller of the Army Signal Radio Propagation Agency. The authors pointed out that the VHF and UHF bands were less dependable and useful than polarities thus elsewhere because of reflecting from the moon that severely handicaps radio location and is dangerous to Doppler measurements.

- Hypersonic re-entry. Problems of communication during hypersonic re-entry and a discussion of both optical and radio transmission schemes that might be used were presented by Dr. F. Long, chief of Aero Manufacturing Corp. Consideration of the report was that re-entry communications is essentially limited to two spectral regions and with water vapor in the earth and the optical region.

- Arctic VLF. Speeches E. assemblies in the Arctic area show a distinct geographical distribution that is extremely

important in planning communications both within the region and between there and the U.S., according to R. P. Smith and S. Conway, Aero Manufacturing Corp., who discussed propagation of VLF in the Arctic. These specific E. assemblies were found to be of three types: the Thule type, the Asovul type, and a third type that mixed both of the other two.

In his paper, Yeh pointed out that over most of the electromagnetic spectrum the earth's atmosphere is opaque.

The most important window occurs in the three decades between about 3 m (10,000 m) and 10 meters (30 m). At the present state of the art, he said, it seems that only line of sight transmission is feasible.

Over the band of frequencies considered feasible for space communications, the thermal noise of the antenna would be predominant at the highest frequencies, while the noise of the receiver would be predominant at the lowest. Therefore, the optimum "threshold" of the system could be expected to be determined by the noise carrier to thermal noise power ratio.

The maximum usable carrier to noise power ratio depends on the modulation techniques used.

An average acceptable figure, however, for present system design would be a value of 15 db.

Satellite observations and wave reflection studies have indicated two types of fading. One, with a period of six months, is believed to be due to the orbital variations in the line-of-sight between the satellite and the receiver. The second type, with a period of about one hour, is believed due to the variation of the electron density of the ionosphere as a result of the effect of the earth's magnetic field.

Other effects such as atmospheric in-



Pioneer Instrumentation

instrumentation package of the Pioneer beam probe launched Oct. 15 (AW Oct. 20 p. 12) contained the following: 1-Duplex command receiver; 2-transmission antenna; telemetry battery; 3-VF half amplifier; 4-TV de-modulator and telemetry modulation; 5-TV battery pack and transmit head; 6-TV driver; 7-TV optical unit; 8-TV command receiver; 9-Magnetron; 10-Magnetron amplifier; 11-Telemetry battery; 12-Duplex for command receiver; 13-Magnetron receiver; 14-Magnetron receiver; 15-Compass; 16-Compass; 17-Magnetron receiver; 18-Magnetron receiver; 19-Magnetron receiver; 20-Magnetron receiver; 21-Magnetron receiver; 22-Magnetron receiver; 23-Magnetron receiver; 24-Magnetron receiver; 25-Magnetron receiver.

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duction in both the atmospheric and the ionosphere and the left structure of the signal due to earth-path from station may also contribute to fading of the received signal. Fading, therefore, may be considered to be a combination of many effects.

In general, a fading margin of 10-18 db or more should be allowed for a reliable system based on presently available radio altimetry data. Extensive beam measurements on a long time basis are required to determine the more reliable fading characteristics.

Mean Relay

A communications system based on use of the moon as a proxy relay is feasible for stations on earth at present if not too high a signal-to-noise ratio is required. The U. S. Navy is studying a Washington to London relay link at this time using the moon as a proxy relay (AW 54a 17, p. 12).

For design of a system using the moon as a proxy relay, a great loss of

248 db between an isotropic radiator and collector for 100 m.e. with a 4 db margin of loss per octave of frequency may be used. This figure also is derived from the data obtained in moon echo experiments.

A sphere with a diameter of 230 in. (17 ft) at a 100 m.e. height would be required to have the same effect as a reflecting body at the moon at 240,000 mi. height. To put a number of 17 ft spheres in orbit appears possible, at the not too distant future.

In earth-to-moon-earth relay systems the number of satellites required depends on the distance between the earth station and also on the height of the satellite above the earth (AW 52, p. 157). The continuous number of satellites required is three, which is set by the geometry and the maximum height of the satellites in the case of the atmosphere.

The dog would take energy from the orbit and cause the satellite to spiral into reentry.

Simulation Facilitates Integrating Bomarc Control Into Sage System

Dello-Simulations designed to give a better understanding of the problems of integrating Bomarc control into the Sage system was discussed here by D. W. Lick and E. W. Wolf of Lincoln Laboratory at the National Simulation Conference of the Institute of Radio Engineers.

Simulation was to create a design tool for specifying the parameters of the Sage computer program with respect to Bomarc and to evaluate the performance of this program in a realistic external environment under a wide variety of conditions.

Series of computer programs called Sage (Sage now real-time) was prepared which simulated automatic Sage functions related to target and missile tracking and missile guidance as well as the external environment of targets, radar and clouds.

Researchers wanted to get data not only on individual intercepts, but on system performance under actually existing intercepts. So Sage has a capacity for 190 tracks and 75 simultaneous intercepts.

Sage is composed of four major components—data generation, target tracking, weapons guidance and tracking package (WGTP), and data reduction.

Each requires a separate part in the IBM 704 computer, and there is no feedback between them.

Radio data generation programs give order range and azimuth information for a maximum of 190 tracks and four radar sites, and the output is a sug-

gestive data with specified radar return and true target positions. This type is the input to the target tracking program which does the automatic location of false-generation of new order data to include position and velocities. From this program come two types which can be provided simultaneously. One is the target type and provides data for the weapons guidance and tracking package. The other is the tracking type and is used for tracking analysis.

The weapons guidance and tracking package carried out missile programs, computing time of launch and generating midcourse commands which the missile model runs along with acceleration equations to generate positions and velocities. Missile tracking programs in addition to target tracking program and associated tracked vessel positions and velocities. The missile track information is fed back to the guidance program.

In the final phase of intercept, Sage simulated the closed loop control action between target and missile. Present data was recorded on an intercept tape.

Input to the data reduction program is either a recording tape or an intercept type. The program computes the power distribution and track other data of interest in target tracking area and intercept data deletion. Outputs are the end result of a complete Sage run.

Technique for reducing the number of runs involved in evaluating system

performance by simulation was described by W. J. Newman at Boeing Aerospace Co. The job of evaluating complex systems like Sage can simplify requirements for very large number of runs in the process.

Newman said the technique consists in simulating the kinds of operating conditions in a batch, rather than an atmospheric environment to be selected in better analysis. He said the new method, which is in use by Boeing, can reduce the total number of simulations required to produce an answer by an order of magnitude.

Battle Simulation

Condensed analog-digital simulation of an air battle between an attacking bomber and a ground controlled intercept system was described by A. B. Proctor, R. C. van Buren and J. W. Wetherill of North American Institute. Simulation was designed to evaluate the effects of various electronic countermeasures on a ground based radar system. It was hypothesized that probability of survival of the bomber would be a better measure of the effectiveness of ECM than evaluation of its effect with radar equipment and operator performance.

In the simulation, an attacking bomber generates ECM against an air craft control radar warning site which in turn can radar indicate and its ap-



Bomarc Section Tested

Hydraulic test chamber applies 30,000 lb compressive loads on the structure of a Boeing Bomarc section. The 99-ton test chamber built by Boeing Aerospace Co. by the Edinboro Plant, Edinboro, Pa., is used at a maximum capacity of 1,500,000 lb. Machine can apply tension, compression, flexure and combined loads. A 3750-hp power source provides heat for structure tests at elevated temperatures.

are. Operator tracks the bomber through successive positions and headings and directs an intercept point to it.

Radio return of the tracking bomber, ECM signals and the various parts of the radar detection process are combined with a modified DRC 101 ECM translator. Simulated radar signals provide a PPI display. While tracking the target, the operator calls position and heading of the bomber to a keyboard operator for recording on an IBM punched card. True bomber position data and time are recorded on the same card, and a set of these cards collectively describes the target's true and simulated tracks. Experiment was conducted for 21 min, the maximum allowable bomber projection time.

Simultaneous control in real time and is currently scaling up to the keyboard's step, except for conversion to digital form for storage on the cards. The cards then become the input to a digital computer. A digital computer program has been written to simulate an intercept controller directing an intercept and to simulate the final phase of the battle between interceptive and bomber. Probability of bomber survival

is then computed and is used as a measure of ECM effectiveness.

Transmitted ground purpose of a radar computer is being built by Auto Radar Division of North American Aviation for reference use. Computer will be delivered next June for use by the National Aeronautics and Space Administration at Langley Field, Va.

Computer will be used initially in an F-101 for research in automatic control, flight control and guidance of air and space vehicles. It was described by H. L. Hayes of Avionics.

Transmitted computer has an all-purpose data storage tape system in reliability, weight, volume and power requirements, according to Hayes, and the system is particularly suitable for airborne use. Initial cost is higher for the translator, design, but often with the disadvantage is expected to diminish through continued development of solid state devices.

Avionics studies indicate that the computing components in the Avionics system will be contained in six major packages, with computer power and reference capabilities as a seventh package. Other major units include an en-

cryption/decryption, tape recorder, tape reader electronics overhead and event recorder, pilot's display electronics and pilot's display. Total system will occupy 22 cu. ft. and weight 855 lb.

Equipment is designed to operate in an unpressurized state where maximum compartment temperature is estimated to be 50°C. No air conditioning is provided, but air channels to package heat sink are in the design, and a fan will provide air circulation.

Computer has 111 operational registers, and other resources computing equipment in the system includes a general-purpose electronic arithmetic logic device. Functions generated with hard-wired electronic logic, electronic matrix, memory patch board, overhead and event recorder, and function relay. To reduce maintenance work time on the system, special ground test equipment is under development.

Interference Effects

Effects of interference on airborne systems of air traffic with radar become critical was studied in a paper by S. J. Nesher and R. K. Coffman of Convair's Worth. Their problem was to determine the quantity of interference and quality of voice performance in a group of aircraft equipped with radio beacon systems. Seven aircraft were put into the test group.

To solve the problem a simulator was built which contained a covering and controlling radio component, a control power functioning as a set of an unmodulated interfering radio and a component functioning as a set of beacon transmitters. A VHF section has a standard radio equipped with radio beacon systems. Seven aircraft were put into the test group.

As a result of the simulation, it was concluded that throughout the programmed interference, the radio operator could maintain visual contact with the beacon radio and could interpret the beacon code under all but the most severe interference conditions.

Edward C. Schuman presented the development of computer systems for jet transport simulation and said that most techniques developed to improve the dynamic response of analog computers in the simulation will give an advantage in other fields of simulation as they become known.

Schuman pointed out that the Link DC-8 simulation was built and modified before the first flight of the aircraft and that test crew were able to gain experience before the first test flight. He also observed that development of the analog computer is at present state in flight simulation and it is necessary to use the simulation as an engineering tool to test new equipment, including major configuration changes under available test conditions.



Gyre Demonstrator

Large multi-engine gyroplane, called "MAGY," for demonstrating gyro principles, was being designed in single or two-engine of fixed-wing, or as a gyroplane. Later, driven by 115 x 60 cpi, motor, operates at 250 rpm. Complete demonstration 18, including automatic control, rotor, gyro, then, problems and suggested demonstrations can be put down in 5215 from AC Sport Flying Division of General Motors Co., Flint, Mich.



HIGH SPEED TELETYPEWRITER, developed for the U. S. Army Signal Research and Development Laboratory by Burroughs Corp., capable of operating at a speed of 3,000 words per minute. Machine is shown here with the cover closed and printing head exposed.

Teletypewriter Has Capability Of 3,000 Words per Minute

New York—Teletypewriter and its capability of operating at a speed of 3,000 words per minute, and with a theoretical top speed of 100,000 words per minute, has been developed by the Burroughs Corp., York, Pa., and the U. S. Army Signal Research and Development Laboratory, Fort Monmouth, N. J. At its theoretical top speed, the teletypewriter would give the equivalent of three complete words in a minute.

New Network

The Signal Corps will use the equipment in part of a new 710 area military communications network, called with such units in high speed type printers and readers where it is capable of replacing eight present military printers. Another unit uses the high speed printing technique in being applied to the problem of making and data from radio low bandwidth control such as Modem which produce information at a faster rate than can be handled by conventional type printers.

Prototype machine is a page-printing, keyboard/reading electronic teletypewriter, operating on the standard

Braille start-stop code, capable of two-way operation. Printed out by a electrostatic recording technique on special paper.

Line width is 71 characters with five lines in the 71. This allows the 12 characters high printing speed, 72 characters are placed in a row in form one printing line.

Each machine is made up of 35 electrostatic heads, seven heads high by five wide, which in different combinations can make up one letter or number.

The machine can make direct images of the letters to be printed in the form of electrostatically charged areas on the high-sensitivity surface of a specially coated paper.

These images are made visible by application of powdered ink which is permanently fixed by passing the paper over a heated roller.

The electronic circuitry of the machine selectively changes the desired combination of the 35 heads in each system so that the letter to be printed appears on all 71 stations. A disintegrator plate is then sent to the back plate or "zero" on the other side of

the paper behind the matrix selected to print.

Deposit of the electrostatic charge requires only about one microsecond. In reading the message to be printed usually in 10 seconds or printing heads and stepping the corresponding page sequentially to each printing head across the line, the printing operation is made entirely electronic, with the exception of paper transport.

Technique Highlights

Features of the technique shown by Signal Corps and Burroughs officials are:

- **High speed.** Pressure mechanism in the printing speed of the machine is the speed at which the paper can be moved. The teletypewriter machine was designed for a top speed of 3,000 wpm, has been operated, according to company officials, at speeds above 12,000 wpm in the laboratory.
- **Reliability.** The direct formation of electrostatic images in a final form printout of electrostatic charges eliminates several intermediate steps and in result a high order of reliability, absence of error and low maintenance cost.
- **Cost.** Machines to handle rates of differing complexity would cost in cost between \$5,000 and \$15,000 in production quantities, according to the company. Paper used by the machines costs about 1.5 cents per square foot, which is slightly more than high grade bond paper.

Other applications of the technique comprise the computer, the calculator, the page printer, digital computer, automatic systems, page printers and plotter, teleprinter, high speed strip charting and facsimile.

Transmission Unit Improves Accuracy

Tucson, Md.—Technique which reportedly increases accuracy of data transmission at non-critical PMDM networks by using a set of 16 bits has been developed here by Eldec Electronics Co.

Increased accuracy is obtained at expense of using two subcarrier modulation and modulator called Vennet, and so the accuracy is made.

Vennet first represents binary data into two voltages over a "carrier" voltage at one of 16 discrete levels (16 discrete levels), the other a "Vennet" voltage at one of 16 discrete levels between the signal voltage and the next smaller one of the 16 discrete voltage levels.

The quantitative noise voltage is applied to one subcarrier oscillator, while the other voltage is amplified by a factor of 16, then applied to the



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blower, can deliver a minimum of 1000/cfm (333 cfm) up to 8 psig, and meets all government-specified altitude and temperature conditions. The M-100 is ordinarily run at 3450 rpm with either electric or gas engine drive.

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► **AME Status Report**—During first 15 months of America Modernization Board's existence, agency has prepared 384 projects and tasks which will require developmental effort, currently has 45 of these under contract.

► **Long-lived Satellite Transmitter**—Manufactured radio transmitter in Vanguard I, powered by Ballantine space solar cells, is still operating after seven months in orbit.

► **Report On Infrared Detection**—Report on the state of the art of heat infrared detectors and photoconductors, including detailed performance and application data, has been prepared by Infrared Industries, Inc. For copy, write to company, P. O. Box 42, Wallingford, Conn.

► **Count-Eye-Aviation equipment** used aboard Air Force's Convair F-106 is accurate within more than 1,000 vacuum tubes and 4,000 transistors, for design, Deputy Secretary of Defense Donald A. Douglas reported at recent National Electronics Conference in Chicago. Development of F-106's avionic equipment required more than 1,000 analyses of engineering and cost more than \$100 million, Douglas said.

► **New Automatic Transmitter Test-Machine** for high-speed fully automatic testing of transmitters, capable of emulating up to seven automatic tests at rates up to 450 tests per hour, has been developed by Stromberg-Carlson for Space Grouping Co. Machine consists of 4½ bells, 4½ beta, 4½ tubes and 4½ relays. Company is completing similar machine for testing diodes, designed to check forward voltage, reverse leakage, Zener voltage and Zener impedance. Machine can be provided with temperature chamber which permits tests to be conducted at temperatures up to 200°C. Only manual operation is the initial loading of the transmitter Machine with rejected transistors according to test details.

► **Special Transistor-Magnetic Generator**—Simple transistor-magnetic burner converter, capable of operating at rates up to two million events per second has been developed by Naval Ordnance Laboratory. Transistors are used as regenerative amplifiers to discharge regenerative state of core when input pulse is applied. Each stage of the converter consists of a parallel core with magnetic bistability loop, a transistor, a silicon diode and a resistor. Duration of output pulse is controlled by saturation fer-

romagnetic density of the core rather than by transistor parameters.

► **Ultimates to Check Solid Propellant-Standard Research Institute** has developed techniques for making ultrasonic to measure remaining serviceable life of solid propellants contained in missiles developed under Hughes Aircraft Co. sponsorship for use with Falcon anti-aircraft missile. Technique applies electrical signal to transducer that is connected to the charge, producing ultrasonic vibrations which are absorbed by propellant. Degree of ultrasonic energy absorbed is proportional to thickness of its remaining service life.

► **Signal on Dotted Line**—Major contract recently awarded by the services commandments include the following:

► **American Machine & Foundry Co.**, \$15.5 million contract from General Electric for radar antenna to be produced at AMF's Brookline, N. Y., plant.

► **Phelps Corp.**, Philadelphia, a \$24 million contract from Army Signal Supply Agency for eight high-resolution airborne radars to be used in close reconnaissance areas.

► **Ryan Aeronautical Corp.**, San Diego, \$10 million contract from Navy for AN/APN 121 (V) airborne Doppler ground velocity indicator.

► **Servotronics, Inc.**, Hawthorne, Calif., reports \$500,000 order from Radio Corp. of America for barometric altitude controllers.

► **Kin-Tel Division of Colson Electronics, Inc.**, San Diego, \$780,000 contract from Douglas Aircraft for closed circuit television equipment to be used for remote observation of missile engines under test at Camp Vandenberg, near Longview, Calif.

► **Macomber Instrument Corp.**, New York, \$166,500 contract for mobile tracking computers and plotters for use at Navy-developed Pacific Missile Test Range, Ft. Meade, Calif.

► **Applied Science Corp.** of Princeton (ASCCO), \$278,000 from Naval Air Training Center for mobile van containing both FM/AM and pulse width modulation (PWM) data selection equipment.

► **General Electric Computer Department**, a \$1.7 million contract received for operating computer control at Army Electronic Missile Agency, Huntsville, Ala., through Sept. 15, 1959.

► **Laboratory for Electronics, Inc.**, Boston, \$190,000 contract from General Electric's Aircraft Accessories Turbine Department for A3-10 electronic engine control to replace mechanical pressure now used in drive for producing thrust power.

► **Frank K. Cook Co.**, Denver, \$140,000 contract for silicones laminates to provide near electrical power for Atlas ballistic missiles.

This announcement appears at a matter of record only

NEW ISSUE

October 15, 1958

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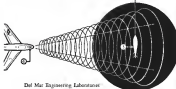
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Incandescent, the units are capable of producing an output of about 9 watts/lb. ft. of active coil area in bright sunlight. Individual coils are obtainable, with or without color-coded pigtail leads, in sizes 1 x 1 cm., 1 x 2 cm., and 1 x 7 cm. Bulbaco SR 775 is available from International Brother Corp., 1521 E. Grand Ave., El Segundo, California.

BEA Viscount Crash Is 'Unexplained'

(Following is a report of a court investigation into the crash of a British European Airways Co. Vickers 582 submitted to H. A. Wallman, Minister of Transport and Civil Aviation, by Richard Adgate, Commissioner.)

It is not proposed to set out new series of the engines and other components are equipment of the aircraft. The design, test, condition and standard of components of some of these was in one way or another during the course of the inquiry. The documentation of the aircraft was complete and in order. No action was taken to replace any of any relevance to the problem from the Coast.

Capt. Robert Malcolm Stewart, who was 35 years old, married with one child. He joined the Royal Air Force in January 1941 and flew 146th, transport aircraft. Having completed the task of Flight Lieutenant Capt. Stewart joined RCAF at Septimont, 1945, and flew as a First Officer of Viking aircraft. He was promoted to Captain in 1949. In March, 1957 he was assigned to Volunteer 802 construction course and his first field check was completed on Oct. 20, 1957. In all Capt. Stewart had flown a total of 7,946 hrs. of which 116 hrs. were on Volunteer 802 aircraft.

He was in possession of a valid United States passport known No. 23790 and was willing to act as pilot of Viscous 602 aircraft on scheduled passenger service. In the last few months before the accident, Capt. Spruick had flown 564 hr and had landed at North Corner on 12 occasions.

There was abundant evidence before the Court upon which it could be satisfied that Capt. Stewart was a reliable officer who would be unlikely to take unjustified risks of deadly safety regulations. The evidence of all those who have had contact with this appreciation of Capt. Stewart's high qual-

First Officer William Gordon Tomlinson was 31 years old, married with two children. He joined the Royal Air Force in 1948 and during his service was awarded for Distinguished Flying Cross. His career went to the rank of Flight Lieutenant and in 1951 joined RFA. Serving at first as Second Officer in Viking service he was promoted to First Officer in 1953. He completed a Vincent 102 conversion course in May, 1957.

That officer had flown a total of 6,719 hours of which 759 he spent in Vietnam on 603 aircraft. He was in possession of a valid active commercial pilot's license No 214213 and was entitled to operate as a pilot of Vietnam 362 aircraft.

In the last six months First Officer Tomlinson had flown 250 hours. All the evidence points to the officer having been competent and sober when the accident occurred.

an instrument on the deck of the *First Officer*. Captain Bryant (40) learned that the light was likely to experience due to the light and the small disseminator was hooked to him. At that time the most significant feature of the weather picture was a cold front was approaching. Bellett from the north. This led the director to expect a decrease in the weather as the lead reached Bellett and an improvement shift if passed they expected it to clear through Bellett (surface 1000 and 1100) to the east of the boat. The weather conditions to be expected in Bellett would be some cloud down to 500 ft, but improvement. Mike from 1000 ft.

The final point referred to the evidence as allowing the aircraft come shortly after 1017 hr when the Zone Commander and Supervisor at Nares Control contacted the aircraft. At that time the Captain was considering diverting to Dübai from Perthshire but at 1018 hr he was told that despite a number of bad local reports that afternoon aircraft had been coming round since about 100-500 ft.

The Supervisor then said "It doesn't seem likely to be very close. I don't know if you've got enough fuel, it might be worth one while coming down to see around a height to see whether you could make an approach." The topic from the aircraft was

A perky, somewhat international, conversation followed in the course of which the possibility of shooting in Adirondack was discussed and double after 10:30 a.m. the search said "if the Adirondack weather has improved that much in previously snowy the forest is going through. I think, and either hang around for a little while and see if we can't get into North Country, or, I could go anywhere here anyway." In the next minute, the search said "the cloud seems very thin. I can see the ground where I am at 4,000 ft."

At 1800 hr, the ground crew found that you've got a sporting chance on a 33 approach, a diamond look too bad." The other crew is "a sporting chance" meant "a sporting chance of becoming visual above visual climb height."

Four witnesses who were on the ground on the right of the approach path at an area between 3 m and 4 m from the threshold were the only people at Natus Canyon who ever saw this aircraft. They all speak of her on the eastern end and

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varying estimates of the accident. Only one of these was more than 500 ft from the (presumed) center line of the runway at its nearest point and he seems to have thought the aircraft was closer to where he was than was real and hence.

Another witness thought the aircraft was higher than usual. Only one of these four witnesses mentions the landing wheel and none they were down. Almost certainly only after seeing it all these witnesses heard the aircraft "roll up." No other witnesses saw the aircraft but several others including some experienced people heard the "rolling up."

To us one did it appear that the aircraft was in trouble at that point they were leaving you in any case.

The crash occurred at 10:11 by "Nabody" saw it. A number of people heard it. The first evidence is that the engine was running up to the moment of impact. A road block followed by the cause of the replacement is the last memory of what was seen and heard by the witnesses.

THE WRECKAGE

The reconstruction of the crash was a fascinating dissection of the structure of the aircraft. The accident and subsequent investigation of the accident investigation Board looked up by the technical staff of the accident, incident, repair facilities and other have failed to reveal to any of our customers which affects the condition of the problem before the crash.

This accident was a challenge to all their highly qualified and experienced people and then met the challenge with dignity and cooperation. It is not their fault that the results are better.

One finding based upon the condition of the wreckage which can safely be made is that at the moment of impact all four engine-mounted units were fully retracted and locked. There are other evidence that on the type of aircraft it takes about 15 to 20 sec. to retract the engine units. The investigation of the wreckage is made the full locked position. The Coast has no reason to doubt that when the aircraft was approaching the station end of the runway the landing wheels were down and concluded that they must have been locked up at the moment they began to retract. It is not possible to conclude that engine-mounted gear had any significant effect on impact at any accident time.

Flip Angle

The flip was found in a condition in which it could be determined that they were in the "flip" position at the time of impact. The maximum flip angle on this aircraft was 47 deg and the evidence would seem to indicate that the flip had been standing up to and had moved to within not more than 5 deg from fully up.

Other reliable evidence suggests that Capt. Stewart would have received 85% (44 deg) flip upon striking the approach lights with, for reasons which will appear, the Coast therefore he was able to do and almost certainly did.

It is reasonable to suppose that he was rotated by ground flip relative aircraft attitude after raising the undercarriage.

There was an equivalent angle on the side view of 4 deg up, equivalent to the



Fins Added to Yak-24

Latest photos of the downed Yak-24 Helicopter show the addition of two vertical fins at the tips of the laterally mounted rotors. Control surface mounted on the tail shaft is not seen. Added fins was probably used for better directional control at high speeds as loss increased drag on the forward rotor by producing a tendency for the rear rotor to swivel, throwing the helicopter into a stall. Photo was taken at Moscow on 10-20-66.

Swivel tendency in the cockpit. The gyro from two slightly sideboard wing low "Nabody" of these accidents is considered as suspect.

A study of the ground at the place of impact suggests that the gear wing had struck the ground a little before the starboard wing had not apparently so. There was positive indication that the aircraft was not inverted.

Much critical work was done to determine the angle of incidence at which the aircraft struck the ground and it is reasonable to make a finding that it was between 45 and 60 deg from the horizon.

It is also reasonable to conclude that the heading of the aircraft was 234 deg at 77 deg to the left of the line of runway 35.

The mean line of action of the nose supported parts of the debris was, however, about 240 deg and this may indicate that immediately before the impact the aircraft had been heading higher than 234 deg.

Propeller Condition

The 15-bladed blades had 160 hrs from 1964 from the time and the evidence more that they were all rotating under similar conditions at the time of impact.

They had been at a pitch setting when the normal constant revving began.

The engines were very badly damaged but it is not possible to determine any circumstances to indicate that they had been rotating at the time of impact and there was no indication of any failure or loss of any of them.

The most obvious instruments on the aircraft were so badly destroyed that it is hard to say that the gear of the two engines were not rotating at the time of the impact those who remained who were left were unable to point to any such problems.

Being typed to a much published

hypothesis relating to a crew door which is decreased later in this Report at it is convenient to record here that the gear of the control system as which a gas could come were accepted and examination of these has produced no evidence of a gas. Although it is not, and was not cleared by the witness to be conclusive the best evidence based on examination of the wreckage is that none of the controls were jammed before the impact.

COMMENT AND DISCUSSION

It has already been mentioned that Capt. Stewart was leader with the approach to "Nabody" and it has been mentioned that the tail boom was the last to become inverted.

Subject to recognition of the statement of the ground evidence it is worth recording that the experience of an officer who knew him well and had often flown with him in a cockpit was that Capt. Stewart was very nervous in flight and that immediately after take off and he would be at about 4,000-5,000 ft. When approaching for discussion he was to the danger for approach from the time he received the undercarriage control was and by manual and he had been the aircraft.

According to the same officer, Capt. Stewart's practice was to leave the clutch engaged with the autopilot selected out. This was the ground practice at that time.

Capt. Stewart was familiar with and learned the standard approach procedure which BGA recommends. Whether he or the First Officer did the flip or the final landing was not a matter for the investigation as the circumstances of any individual in flight.

He was regarded as a meticulous worker of all his approach speed.

There was good evidence that the First Officer Tashkov was familiar with the standard approach.

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BYRON BULLOCK BETTER CHANCE

though the engineers were confirming the Coast was studied that during the study of the period of the mid-1950s it was of the aid of low intensity approach lights, the aid of directional lights, the green low intensity directional lights and all six of the white directional runway lights were slight.

Instructions Followed

On the balance of probability the Coast was studied that during the study of the period of the mid-1950s it was of the aid of low intensity approach lights, the aid of directional lights, the green low intensity directional lights and all six of the white directional runway lights were slight.

In all the recommendations the Coast must have an explanation of this disaster based upon pilot error.

If pilot error is to be eliminated from among the probable causes of this accident it becomes the most important to study. These factors which might produce subjective errors might be errors of vision, misinterpretation of the mechanism of the aircraft which the crew could not detect or which would be unable to correct. The possibility of some thing preventing the controls a case that has always been in the mind of those concerned with the design and operation of aircraft.

It was an engineer before the Coast that RCA has a training order which has been a reference for many years, the training of which is to identify any possibility of those things being left alone in the cockpit of aircraft. Function is also made comparing these with the design and operation of aircraft. The various procedures "check" to verify themselves that no such as verify checks are left behind when pilots are out of the cockpit after a crash in which a crash was reported as the cause of the crash.

So far as the Vindicator 502 is concerned the last evidence was that the only one of

the symbols into which a design might could find its way was the design of the symbols in the post pilot's platform. After going through the complete manual system of the symbols, which was the design of the symbols of the Vindicator 502, it was not clear to find any other place into which any but significant things might find its way.

It is the practice of those builders to meet from time to time to specify all their symbols, including modifications which might be made and development has shown to be desirable in the case of any given type.

On Sept. 19, 1957, no other more than a month before the accident was only one advertisement the builders got out a bulletin recommending the closing of an approach through which, in their Inspection Department, they could not see, although they had the control section, preventing the aircraft. This recommendation was not made because of any actual experience of something of the sort happening, but because the engineers anticipated that such a thing could happen.

Recommendations for modifications for all of their builders are given a position relative to the design of the aircraft, through "single description" and "double" to "triple" and the modifications are in order documents which give the rules "New side."

Joining Incident

The modification was not immediately put in hand by RCA, a large number of "double" modifications are suggested from time to time and those are added and applied in left when necessary. On Nov. 4, 1957, a large number of double after the accident, under investigation, there was an accident involving the joining of the plane controls at another Vindicator 502 aircraft in a line that into a scheduled flight one which had left through the air traffic. A few days later a single aircraft left through the same airport on another aircraft and worked its way off on the lower level and behind in a vulnerable



Braniff Maintenance Base Opens at Dallas

Braniff Airways has constructed a new maintenance and operations facility at Love Field, Dallas, Texas, which includes two large hangars that can handle six four-engine transports at a single time. Check-out and maintenance shops are located between the hangars in the center section of the facility. Cranes are also provided for use by Braniff for the control power, light operations and engineering. The \$6.5 million base was financed through Dallas municipal revenue bonds. Braniff leaves the facility from the city.

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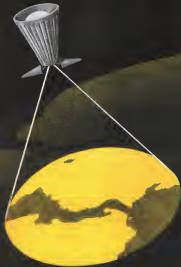
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vacuum desired in the atmosphere so far as can be possible of conditions which may lead to the leaving of tools or other objects there in as much as such a view as to cause any possibility of the loss of material which has had to be considered in the case of this investigation.

QUESTIONS AND ANSWERS

The Coast's answers to the questions submitted by the 'Antares Coastal' are as follows—

Q Who were the owners and operator of the aircraft?

A Southwestern Service Corp.

Q At the time of the accident?

A (a) Had the aircraft been properly maintained in accordance with the current record maintenance schedule?

(b) Was the aircraft properly loaded and secured?

(c) Were the crew properly briefed and adequately instructed in the flight?

A (a) Yes.

(b) Yes.

(c) Yes.

Q What was the cause of the accident?

A Unknown.

Q Was the accident due to, in connection to, the wrongful act or default of any party or of any person in the custody of that party?

A Indeed it is hard to say whether or not it was.

Editor: Answer

Q I. L. Greenleaf

Q B. Jackson

Oils More Effective When Air Is Absent

San Antonio-Southwest Research Institute has found that certain lubricants have an increased capacity for lubricating high speed gears when they operate in an airless atmosphere. Lubrication studies are being conducted here under Air Force contract.

Southwest Research Institute discovered that gears lubricated in straight mineral oil and operated in airless atmosphere show a marked increase in load-carrying capacity. Nitrogen or argon vapors act as the operating atmosphere. The same results were obtained when mineral oil was fortified with phosphorus, sulphur and chlorine type additives.

Data gathered so far indicates that load-carrying capacity is appreciably elevated in an environment where air is removed or where the lubrication area is saturated with an inert gas like nitrogen. Studies are now under way on the effect of this phenomenon on other lubricants.

Southwest Research Institute points out that increased load-carrying capacity can be an important factor in keeping gear weight to a minimum in one system. Advantages are anticipated in designs of missile systems because of the problem of providing adequate lubrication to remote powerplants.

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WHO'S WHERE

(Continued from page 27)

Changes

Rocketdyne, a division of North American Aviation, Inc., Azusa, Calif., has announced the following appointments: V. J. Judd, assistant program manager for the liquid oxygen program and the H-1 program for the Army Ballistic Missile Agency; D. J. Sandhu, assistant program manager for the Air Force sponsored E-1 and F-1 programs for liquid-fueled liquid propelled rocket engines.

Merle M. Robinson, Jr., chief supervisor, Calvert Chemical Co., Pittsburgh, Pa.

Miss Stuart S. Meier (ASAE, etc.) is named to the general manager, Aerospace Development Division, Goodyear Corp., Santa Barbara, Calif.

Barney Anderson Co., Seattle, Wash., has announced the following appointments: Forster D. Ryan, product manager, and Harold C. Tinsley, chief business planning staff, Systems Management Office; Carl A. Krell, assistant manager of the IN-19 (Interim) Weapons System, Phoenix Naval District; George White, superintendent of assembly, Seattle Division.

Robert H. Bates, assistant director of domestic commercial sales, Douglas Aircraft Co., Inc., Santa Monica, Calif.

Roger L. Smith, manager systems department, Technical Operations Control Project Computer Division, Aerospace Systems, Inc., subsidiary of Ford Motor Co., Santa Ana, Calif.

Robert H. Lane, director of public relations, Goodyear Tire and Rubber Co., Akron, Ohio.

Robert H. Rosenberg, director of plans and contracts, Air Logistics Corp., Pasadena, Calif.

Robert C. Scholtz, senior application engineer, aerodynamic, Vought Aircraft Co., Van Nuys, Calif.

Charles J. Gilbert, administrative vice president, the Strategic Corp., Redland, Calif.; the Donald J. Fennerty, research engineer, and Howard M. Turk, field service engineer.

David Doss, the director of public relations and advertising, Aerojet Corp., Van Nuys, N. J.

William G. Cox, Pacific Division manager, Los Angeles, Calif., Hughes Corp. of America, Clifton, N. J.

Bert Remick, sales manager in charge of the new industrial weapons, D. C. office C. F. Chen & Co., Chicago, Ill.; Col. William M. French (USMC, etc.), command officer, military, Aerojet General Corp.'s Solid Rocket plant, Sacramento, Calif.

C. W. Flanagan, director, manufacturing, and C. Wright Kellogg, sales manager, missile, Quesada Division, Aero Manufacturing Corp., Chardon, Ohio.

Warren F. Fife, assistant manager flight operations, North Aircraft Corp., Wallula, Wis.

Stanley Schneider, manager of engineering, Hight Division, Bellman Instruments, Inc., Norcross, Ga., Calif.

Bruce M. Caines, director of engineering, The Regge Foundation Co., Washington, D. C.

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British Work enhances the spirit of co-operation in the common pursuit of

Being a faithful reader of your magazine, which I feel is the best of its kind on the market, I feel given me the right to make the following comment:

I can't help thinking that much publicity is given to the Boeing "U" and very little to competitive jet aircraft. Your articles on the "U" are very interesting and should continue, but I feel that more information on the progress of the DC-8 and others should have equal publicity. I consider DC-8 because I happen to work for the company building such. Let it be known that the savings expected in this letter are true and do not necessarily compare with those of the company. I work for

December 1948

Literature: *Colt* (Llandudno) gives parents listing of shows, articles and pictures. *Amateur World* has published on such subjects as the *Canine Mail*, *Cover* or *600*, *Doublet*, *DC's* and *Landlady*. *Electro* has the following references as representative of our major coverage: *Cine* 100 (1977) Jan 1, p. 52, (1983) Feb 5, p. 40, p. 41, March 7, p. 44 Oct 15, p. 41 *Canine* 600 (1978) April 5, p. 9, (1978) Aug 4, p. 35, Sept 8, p. 30, Sept 15, p. 92 *DC's* (1978) April 21, p. 102, April 28, p. 80, June 9, p. 29 *Look and Learn* (1978) March 31, p. 46 April 7, p. 78, Oct 28, p. 82-83d, 1.

Many a natural agricultural engineer concurs with van Oortwille, who sees constantly expanding sectors of our life of technological marvels, with the farmers as like complements like delivery of useful services, etc.

However, many of us believe you have overlooked two additional reasons for why students which puts a weight aside to the sociological by Nussli: the inefficiency and attitudes of our prime scrap systems and contractors and the lack of any professional management agencies to focus and guide contractors to provide the desired scrap services they need and can have. For example, a major waste management in most one and half years behind in being schedule, some of our first few scrap systems are not as reliable as they should be, and they are not as reliable as they should be. The fact that they are failing to do this can be the best indicator of the quality and success of our scrap systems. It is second year that our schedule is not met, and we are

The question is, why does the condition exist? Of course, there are many reasons, but one reason that a prime concern is believed to be the lack of technological and organizational maturity, with many of our engineering management personnel working for a primitive design office environment.

You cannot expect efficiency, without attitudes and well informed engineering decisions and policies unless they are sustained by informed engineering personnel. When poor decisions are made by the user, you have inefficient systems whether

Anonymous Work undermines the openness of its residents on the issues raised in the magazine's editorial columns. Address letters to the Editor, *Anonymous Work*, 230 W. 42nd St., New York 36, N. Y. Try to keep letters under 200 words; include a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

usable weapon systems, despite its schedule like philosophy, tremendous sacrifice in costs, and the costs to cover up blunders. This does not include the post decisions these same men put on to these schedules and collections.

Most of our present disaffected engineers are managerial personnel who, as shown in our survey with highly specialized engineering backgrounds, have been in the organization for a long time. They are middle-aged, group experts, etc. This is not a new phenomenon. The reason for it may be not technically advanced to make a career income because it means giving up the high salary and the high status and the limited background experience to make him technically trained. Engineering management personnel today require the same kind of training. They are not the engineers flight for customer satisfaction, maintenance, procurement, manufacturing, project engineering, design, industrial design, etc. They are the people who are in charge of engineering management. The last step is to give this necessary preparation to let them continue to advance along with the organization. In 10 years, 20 years, 30 years, we must be able to produce such men. Our engineering management or top line men (Topo) and a pilot line men (Pilo) are the people who are in charge of the organization, with the Executive Management Group, with the Executive Group, or Chapter in which they have spent most of their life and which they are

30 Year Aeronautical Engineer
San Diego, Calif.

Although not usually important in other proteinases, it does seem wise to look into overhauling some of the malfunctions GAA involves.

With the placing on sale by the government of a number of ex-fleet surplus aircraft such as North American T-28s, Grumman F4Fs, Lockheed P-2Vs and Consolidated P-38s-4As, buyers find themselves unable to fly their airplanes for their own personal use solely because the old leasehold certification arrangement was defunct. It ended on Jan. 1, 1959.

However, the paper-lensed picture is not in CAS or Montage so they had to go to somebody that built a Marlin (those experimental lightbulbs in Marlin in the garage and give a warning "well done" if you decide to do a late night automatic message carrying before in mid 1920s). Custom Robot (CAS appeared, Standard Catalog) which, after all, is safe as can be with that trace 1915, maybe OS-1 again (OS again, it's wrong a CAS type on clients number on its client).

E. D. Wilson
Los Angeles 46, Cal.

In general one can find very little to disagree with in your extremely successful

The one awarded "Space Time Lecturer" of Aug 18. Your quality of telling a good story is much needed now both in industry and in the government. It is a top notch talent selection for this country. In your report that the best qualified scientific and technical personnel of high integrity, such as Dr. Divaris, are not appointed to top government positions especially where they are available for such positions. Maybe this

is due to the lack of genuine scientific and technical ability and/or honesty as well as to political motives at high levels in the government. Also, it seems that the badly needed sense of urgency for real scientific research (programmed as a routine bureaucratic mass production throughput) for government has November has sounded a flare of the usual complacency or pseudo-scientific stunts possibly to be extended open only to further decrease dissemination of real significance in the dry or otherwise. Is some honest comment

Along with that, the author notes that it is essential to conclude that salaries for scientific and engineering personnel working on government contracts must make clear salaries and probably no, however, it might be the best of other expenses (such as housing, travel, salaries) are considered as directly. It is important to understand that the author is not a while those of technical personnel are represented as an indirect expense (possibly categorized on paper as that which is not on paper appear later) it is quite possible.

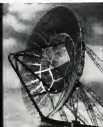
With high grade scientific and engineering education, we will be better positioned to lead.



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